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REPORT OF THE

51st NATIONAL CONFERENCE ON WEIGHTS AND MEASURES 1966

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
MISCELLANEOUS PUBLICATION 290

THE NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards is a principal focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. Its responsibilities include development and maintenance of the national standards of measurement, and the provisions of means for making measurements consistent with those standards; determination of physical constants and properties of materials; development of methods for testing materials, mechanisms, and structures, and making such tests as may be necessary, particularly for government agencies; cooperation in the establishment of standard practices for incorporation in codes and specifications; advisory service to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; assistance to industry, business, and consumers in the development and acceptance of commercial standards and simplified trade practice recommendations; administration of programs in cooperation with United States business groups and standards organizations for the development of international standards of practice; and maintenance of a clearinghouse for the collection and dissemination of scientific, technical, and engineering information. The scope of the Bureau's activities is suggested in the following listing of its three Institutes and their organizational units.

Institute for Basic Standards. Applied Mathematics. Electricity. Metrology. Mechanics. Heat. Atomic Physics. Physical Chemistry. Laboratory Astrophysics.* Radiation Physics. Radio Standards Laboratory:* Radio Standards Physics; Radio Standards Engineering. Office of Standard Reference Data.

Institute for Materials Research. Analytical Chemistry. Polymers. Metallurgy. Inorganic Materials. Reactor Radiations. Cryogenics.* Materials Evaluation Laboratory. Office of Standard Reference Materials.

Institute for Applied Technology. Building Research. Information Technology. Performance Test Development. Electronic Instrumentation. Textile and Apparel Technology Center. Technical Analysis. Office of Weights and Measures. Office of Engineering Standards. Office of Invention and Innovation. Office of Technical Resources. Clearinghouse for Federal Scientific and Technical Information.**

*Located at Boulder, Colorado 80301.
**Located at 5285 Port Royal Road, Springfield, Virginia 22151.

Report of the 51st National Conference on Weights and Measures 1966

Sponsored by the National Bureau of Standards
Attended by Officials From the Various States, Counties, and Cities, and Representatives From U.S. Government, Industry, and Consumer Organizations
Denver, Colorado, July 11, 12, 13, 14, 15, 1966

Report Editor: L. J. Chisholm

United States Department of Commerce
Alexander B. Trowbridge, Acting Secretary

National Bureau of Standards
A. V. Astin, Director

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OFFICERS

(As elected by the Fiftieth National Conference to serve during the Fifty-first)

President: A. V. Astin, Director, National Bureau of Standards.
Executive Secretary: M. W. Jensen, Chief, Office of Weights and Measures, National Bureau of Standards. } *Ex officio*

Chairman: J. F. True, State Sealer, Division of Weights and Measures, State Board of Agriculture, State of Kansas.

Vice Chairmen:

E. H. Black, County Sealer of Weights and Measures, Ventura County, California.

L. L. Elliott, City Sealer of Weights and Measures, Everett, Massachusetts.

M. Jennings, Director, Division of Marketing, Department of Agriculture, State of Tennessee.

J. L. Littlefield, Chief, Food Inspection Division, Department of Agriculture, State of Michigan.

Treasurer: C. C. Morgan, City Sealer of Weights and Measures, Gary, Indiana.

Chaplain: R. W. Searles, County Inspector of Weights and Measures, Medina County, Ohio.

OFFICERS

(As elected by the Fifty-first National Conference to serve during the Fifty-second)

A. V. Astin, *President*
M. W. Jensen, *Executive Secretary* } *Ex officio*
J. E. Bowen, *Chairman*
C. O. Cottom of Michigan, *Vice Chairman*
R. H. Fernsten of California, *Vice Chairman*
F. M. Gersz of Connecticut, *Vice Chairman*
J. G. Gustafson of Minnesota, *Vice Chairman*
C. C. Morgan of Indiana, *Treasurer*
R. W. Searles of Ohio, *Chaplain*

EXECUTIVE COMMITTEE

(As elected by the Fifty-first National Conference)

A. V. Astin
M. W. Jensen
J. E. Bowen
C. O. Cottom
R. H. Fernsten
F. M. Gersz
J. G. Gustafson
C. C. Morgan
R. W. Searles
} *Ex officio*

J. R. Bird of New Jersey.
S. J. Darsey of Florida.
R. J. Fahey of Illinois.
I. R. Frazer of Indiana.
M. Greenspan of New York.
W. H. Holt of West Virginia.
D. E. Konsoer of Wisconsin.
J. H. Lewis of Washington.
W. A. Polaski of Pennsylvania.
J. D. Walton of Texas.

STANDING COMMITTEES

(As constituted at the conclusion of the Fifty-first National Conference, the personnel of each of the standing committees are as listed. The remaining term of office for each committee member, in years, is shown in parentheses following each entry.)

EDUCATION*

S. H. Christie, Jr. of New Jersey, Chairman (1).
L. A. Gredy of Indiana (2).
A. D. Rose of California (3).
W. I. Thompson of New Jersey (4).
J. I. Moore of North Carolina (5).

LAWS AND REGULATIONS*

M. Jennings of Tennessee, Chairman (1).
L. Barker of West Virginia (2).
H. L. Goforth of Illinois (3).
J. F. Lyles of Virginia (4).
W. A. Kerlin of California (5).

SPECIFICATIONS AND TOLERANCES*

G. L. Johnson of Kentucky, Chairman (1).
J. F. McCarthy of Massachusetts (2).
H. D. Robinson of Maine (3).
C. H. Stender of South Carolina (4).
R. Rebuffo of Nevada (5).

COMMITTEE ON LIAISON WITH THE NATIONAL GOVERNMENT*

A. L. Little of Arkansas, Chairman (4).
K. C. Allen of Ohio (3).
R. J. Fahey of Illinois (2).
C. E. Joyce of Minnesota (1).
R. C. Primley of Michigan (5).

ANNUAL COMMITTEES ACTING ONLY DURING THE FIFTY-FIRST CONFERENCE

Nominations: R. Williams of New York, *Chairman;* E. H. Black of California; V. D. Campbell of Ohio; H. E. Crawford of Florida; J. B. McGee of Georgia; R. E. Meek of Indiana; D. M. Turnbull of Washington.

Resolutions: E. W. Ballentine of South Carolina, *Chairman;* B. S. Cichowicz of Indiana; G. L. Delano of Montana; R. H. Fernstein of California; D. E. Konsoer of Wisconsin; W. A. Polaski of Pennsylvania; R. K. Slough of Ohio.

Auditing Committee: N. P. Tilleman of Wisconsin, *Chairman;* H. N. Duff of Colorado; I. R. Frazer of Indiana.

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*M. W. JENSEN, Executive Secretary of the Conference, is *ex officio* nonvoting secretary to each committee.

COMMITTEE MEETINGS, MONDAY, JULY 11, 1966

All day Monday was set aside for meetings of the Conference committees. Announcements of these meetings were carried in the National Conference Announcement and in the Conference Program.

The Conference committees that met on Monday morning were the Executive Committee, the Committee on Liaison with the National Government, and the Committee on Laws and Regulations. The Committee on Education and the Committee on Specifications and Tolerances met on Monday afternoon.

All final reports of the Standing and Annual Committees can be found beginning on page 131.

REPORT OF THE FIFTY-FIRST NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

MORNING SESSION—TUESDAY, JULY 12, 1966

(J. F. True, Chairman, Presiding)

The invocation was delivered and the memorial service for departed members was conducted by the Conference Chaplain, Rev. R. W. Searles of Ohio.

Rev. Searles led the delegates in the Pledge of Allegiance.

ADDRESS OF THE CONFERENCE PRESIDENT AND APPOINTMENTS TO STANDING COMMITTEES

by A. V. Astin, *Director, National Bureau of Standards*

I am truly pleased to be able to be with you here today on this unique occasion—the first National Conference on Weights and Measures that has been held outside of Washington. I believe that the difficulty many of you had to go through in order to be here today demonstrates the interest that all of you have in this Conference and in the deliberations that take place here.

I would like to read you a greeting from the governor of our newest State:

> Aloha and sincere best wishes for another outstanding National Conference on Weights and Measures. As you lead the Conference in its fifty-first year, you are cognizant of the special service rendered by the Bureau of Standards to the people of all States.
>
> The State of Hawaii has instituted a statewide measures and weights program effective January 1, 1966. The metrology program, under the guidance of your office and, in particular, Mr. Malcolm W. Jensen, is proceeding on schedule. We hope to be fully staffed and equipped for standardization work by October 1966. We will continue to support and participate in the program and activities of the National Bureau of Standards on weights and measures.
>
> Warmest personal regards. May the Almighty be with you and yours always.
>
> Sincerely,
> John A. Burns, Governor.

Thank you, Governor Burns, for your greetings.

This Fifty-First Conference has another distinctive feature apart from its location: We are meeting, in one of our sessions, with the Instrument Society of America. The great concern of the members of this Conference with the problems of instrumentation and metrology make it important to strengthen our ties with organizations such as ISA. I am very hopeful that the sessions we have scheduled in cooperation with them will be most fruitful.

It is my responsibility and pleasure to report on the current status of activities in the National Bureau of Standards. I believe the most important recent development of interest to the members of this Conference is the beginning of furnishing new sets of standards to the States. As many of you know, the Conference many years ago adopted a resolution urging the National Bureau of Standards to seek funds to provide these new standards and we receive, in our appropriation for Fiscal Year 1966, $400,000 to begin this program. The standards are now under construction and we expect to begin delivery of the first ten sets this coming fall. The States that have been selected to receive the first ten sets of standards were selected on a basis of need and ability to use the standards. As I think most of you are aware, these standards represent the ultimate in precision for reference standards, and they are far enough in advance of the standards now generally in use to require considerable advances or extensions in laboratory equipment and training of personnel to permit their effective exploitation. So we have used the combination of need for new standards and the ability to use the standards in selecting the first ten States. We hope that funds will be provided by the Congress for this fiscal year for the next ten, and that over the next few years we will complete the program of furnishing the standards to all fifty States. These first sets will go to, in alphabetical order: California, Connecticut, Delaware, Illinois, Kentucky, New Mexico, Ohio, Oregon, Tennessee, and Utah. I think it is significant that this program of furnishing new standards to the States will begin on the hundredth anniversary of the last time this was done on a nationwide basis. It was in July of 1866 that the Congress last made provision to do this job.

In furnishing these standards to the States, we would like to have some symbolic evidence of this program at our new site in Gaithersburg, Maryland. We are inviting each of the States, as they receive a new set of standards, to donate a tree representative of the State which can be planted at Gaithersburg in an appropriate area.

In mentioning Gaithersburg, I would like to report the progress in our relocation. Most of the construction there is now complete. We are in the process of moving people into the new laboratories and,

at present, we have just a little over 50 percent of our Washington staff now located in the new facilities.

We have also just begun the final construction phase, which consists of four special-purpose laboratories. These laboratories will not be completed until late in 1968, but they will house only a small portion of the staff. In the laboratories now available we will be able to house approximately 90 percent of the staff, and it is expected that this 90 percent will be located in the new facilities by the end of this year. Late in the fall, we are planning a formal dedication of the new facility.

I would also like to bring to your attention the fact that we have been preparing a comprehensive history of the National Bureau of Standards. We have been working on this project over the past five years, and expect it to appear this month. It is to be published by the Government Printing Office, and its title is "Measures for Progress." We have selected as the date for the formal publication July 28, 1966, which is the hundredth anniversary of the legalization of the Metric System in this country.

During the past year, we have been very active at the National Bureau of Standards in categorizing our program in terms of new definitions promulgated by the President and the Bureau of the Budget. This effort, government-wide, is called the Planning-Programming Budgeting System. The objective is to aline all Federal Government activities in terms of programs whose outputs can be measured. The general goal is to attempt to provide better criteria for choice among the many activities that the Federal Government must engage in so that return per dollar can be optimized.

Within the National Bureau of Standards, we have reached the conclusion that our activities can be summarized under four major program categories, each of which permits some means of evaluating or measuring the output qualitatively, if not quantitativly. The first of these four program categories is called Basic Standards, and the goal of this program is to provide the central basis for uniform compatible measurement in this country. It begins with setting up the basic standards, with extending the standards through higher and smaller values, with the extension of the basic standards into approximately forty-five derived standards, and with providing measurement and calibration services for the effective utilization of these standards throughout the Nation. Your own program of the Office of Weights and Measures is a part of this basic program category of the Bureau.

The second major program category is the Numerical Data program. This involves the determination of properties of matter and materials that are of great importance to science and industry and which are not available in sufficient accuracy elsewhere. The work

involves a deep understanding of the properties of materials, of the relationship of properties to composition and structure. It also embraces our National Standard Reference Data System, which I have mentioned in previous sessions of this Conference, dealing with compilations of critically evaluated data.

Our third program category is called Engineering Measurements and Standards. This activity it primarily concerned with providing criteria for the effective evaluation of commercial technical products and services, and the development of test methods to permit application of these criteria.

Our fourth general program category is called Technical Assistance to Government, and its goal is to aid other government agencies in the utilization of modern science and technology. Important in this area are programs in automatic data processing systems and in building research.

With the formulation of our program under these four major categories, we are now attempting to formalize subcategories and to measure the effectiveness of our output in each subcategory.

A year ago, I reported to you that plans were afoot to create a new Environmental Science Services Administration within the Department of Commerce and the plan to transfer to it our Central Radio Propagation Laboratory here in Boulder. That plan went through and the Central Radio Propagation Laboratory is now no longer a part of the Bureau. ESSA is celebrating, by coincidence, its first birthday tomorrow, and perhaps during your visit to Boulder tomorrow and to the NBS Radio Standards Laboratory, you may see part of the ESSA birthday celebration in progress.

New responsibilities continue to be added to the National Bureau of Standards. The Congress, last summer, enacted a law dealing with automatic data processing problems and assigned to the Bureau the central responsibility for assisting other government agencies in the utilization of these new techniques and for developing standards for automatic data processing systems in order to facilitate the interchangeability of such equipment and techniques.

In order to implement this responsibility, we established in the Bureau a Center for Computer Science and Technology last fall.

There is now pending before the Congress legislation which, if enacted, would bring additional responsibilities of rather serious impact. The largest of these is the legislation dealing with automotive and transportation safety. If this legislation is enacted, it seems likely that the National Bureau of Standards will have a central responsibility to provide the technical basis for development of automotive safety standards. This would involve the development of the necessary performance criteria and the development of test methods to evaluate conformance to these criteria. If this legislation is enacted

and the responsibility now planned is assigned to the Bureau, the budget for this program may approach the present basic appropriations of the entire National Bureau of Standards.

Another item now pending before the Congress is the so-called "Fair Packaging and Labeling" legislation. This, of course, is legislation of great interest to this Conference since you have many activities related to it. The involvement of the Bureau in this legislation, if enacted, will be the provision of voluntary standards development procedures. As I think many of you know, we have had a Commodity Standards program whereby we work with industrial groups in the development of standards which are then promulgated and adopted on a voluntary basis. The legislation now pending before the Congress makes provision to use this mechanism to arrive at many of the standards which are important in the packaging field.

A third item has been pending for some time in the legislative field, but the forecasts for its enactment this summer appear good. This is the legislation which would direct the Secretary of Commerce to study the problems associated with the increased use of the Metric System throughout the world. If this legislation is enacted, it would, of course, involve a major effort on the part of the National Bureau of Standards to carry out this study. If this is done I am sure we would want to call on many of our friends associated with this Conference for help in developing recommendations.

Our Chief of the Office of Weights and Measures, Malcolm Jensen, who has done so much work throughout the years for this Conference, is a man of many talents. We have found it necessary, in line with the Bureau's increasing responsibility in the standards field, to give Mr. Jensen a large responsibility. He is now our Manager of Engineering Standards and has responsibility not only for the Office of Weights and Measures, but for our program generally in Engineering Standards, particularly our Voluntary Products Standards program.

In this field, Mr. Jensen has taken the lead in implementing one of the important recommendations of the Committee on Engineering and Commodity Standards set up under the Secretary of Commerce some time ago. Their recommendation in the commodity or product standards area was that we revise our procedures for developing these standards in order to assure better technical review and to include a broader range of viewpoints from the many interests concerned with such standards. These new procedures were promulgated by the Department of Commerce last December, and we are now applying them under the leadership of Mr. Jensen. I am sure that many of you will regret that he is now no longer concerned full-time with weights and measures, but I am sure you will appreciate that his talent has made it necessary to give him larger responsibility.

I would like to mention just a few of the technological achievements within the Bureau's program. It would be impossible to cover very many of them, but I think the following are of special interest:

First, at our new Gaithersburg facilities this past year, we have instituted direct weighing calibrations up to 1-million pounds. Our new engineering mechanics laboratory there was justified to an appreciable extent by the need to improve our accuracy in direct weighing of values this large. Our million-pound constant weight machine was made operative during the past year. Associated with this, we have just completed a many-year study and redetermination of the acceleration of gravity with improved accuracy. This important constant is essential to the translation of our mass standard to a weight and force standard.

We have instituted new calibrations of thermometers in the range below 20 degrees Kelvin. We have instituted a number of new and improved calibration services in the radio frequency field. This, of course, is an activity which is the responsibility of our Radio Standards Laboratory at Boulder here in Colorado.

We have developed a number of important new standard reference materials, and in this general area of materials research we have come up with a radically new method for purifying materials which seems to offer the possibility of achieving near absolute purity—achieving purity so high, it is extremely difficult, if not impossible, to measure.

I now come to one of the most pleasurable parts of my responsibility, and that is the naming of new members to the Standing Committees of the Conference.

On the Committee on Education, I am appointing W. I. Thompson of Monmouth County, New Jersey, for a four-year term to succeed John Madden who resigned to accept a position in industry. I am appointing J. I. Moore of the State of North Carolina for a five-year term to succeed J. T. Daniell of Michigan.

On the Committee on Laws and Regulations, I am naming W. A. Kerlin of the State of California for a five-year term to succeed J. L. Littlefield of Michigan.

On the Committee on Liaison with the Federal Government, I am naming R. C. Primley, Operation Manager of the Theisen-Clemens Company, St. Joseph, Michigan, and Chairman of the A.P.I. Weights and Measures Technical Committee, for a five-year term to succeed F. W. Love.

On the Committee on Specifications and Tolerances, I am naming Raymond Rebuffo of the State of Nevada for a five-year term to succeed H. J. McDade of California.

I would like, at this time, to give my sincere thanks to the members of these committees who have completed their assignments for their

interest and devotion to the work of the committees of the Conference. I would also like to thank all of the other members of the Conference for their contributions to our joint objectives.

I would again like to say that I appreciate very much the opportunity that the National Bureau of Standards has in working with the weights and measures officials of the States and individuals from industry to carry out the important goals of the Conference, and I also appreciate my opportunity to participate in these activities. Thank you very much.

PRESENTATION OF HONOR AWARDS

Dr. Astin presented Honor Awards to members of the Conference who by attending the 50th Conference in 1965, reached one of the four attendance categories for which recognition is made—attendance at 10, 15, 20, and 25 meetings.

AWARD RECIPIENTS

25 Years

C. D. Baucon
J. P. McBride
R. E. Meek
C. C. Morgan

20 Years

S. H. Christie, Jr.
L. G. Close
H. E. Howard
R. D. Thompson

15 Years

Mrs. F. C. Bell
S. Black
F. C. Harbour
J. E. Mahoney
A. E. McKeever
C. H. Stender
C. E. Wagner

10 Years

A. J. Albanese
P. Grassi
H. H. Houston
H. P. Hutchinson
V. C. Kennedy, Sr.
B. C. Keysar
A. J. Komich
G. P. Kosmos
R. V. Miller
J. E. Myers
C. H. Oakley
A. D. Rose
C. W. Silver
W. R. Tilley
H. M. Turrell
I. L. Wagner, Jr.
C. E. Whitman

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ADDRESS

by J. P. Orcutt, *Commissioner, Department of Agriculture, Denver, Colorado*

The Governor wanted to be with you today but, through some mixup in scheduling, he could not attend. But he does welcome you to the State and hopes that you have a very profitable and fruitful Conference.

We feel it is an honor for Colorado to have been selected for your first meeting outside of the Washington area. I know one of the influences in the selection of Colorado was the National Bureau of Standards Laboratories in Boulder.

This facility, which includes the radio and electronics laboratories, will be one of the stops on your bus tour tomorrow. We are proud of this development in Boulder. The NBS Laboratories have attracted growth industries to the State. Valuable contributions to the State economy and the growth of a scientific community are only parts of the story that put NBS in an excellent position as being among Colorado's greatest assets.

I would like to take a few minutes to talk about Colorado's agriculture and points of interest in the State. I would like to start with the eastern plains where we just completed a rather bountiful wheat harvest. We have thousands of acres on the eastern plains of Colorado devoted to wheat and interspersed with many large cattle ranches. Also in that area, we have the Rocky Ford cantaloupe that is grown extensively and shipped all over the country, and I am sure you have heard of this particular Colorado product.

Then we move on to the beautiful San Luis Valley in its mountain setting where we raise lettuce, carrots, potatoes, all kinds of vegetable crops, and we know that these are some of the best grown in the world. At that high altitude and with the lack of rainfall being practically all irrigated, there are grown some of the best vegetable crops in the country.

Then, farther over, we run into the Durango and Cortez area where we raise the pinto beans, and again we go back to the lower level where we have wheat.

Farther up at Delta, Palisade, and Grand Junction, we have our Colorado fruit orchards with cherries, peaches, apricots, pears, and so forth.

Then we come back over on the eastern side and we have Weld County which ranks fifth among the counties in the United States in total crop production. We are pretty proud of this particular county.

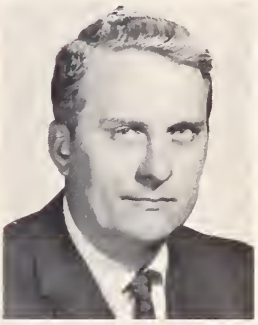
They raise a wide diversity of crops up there—vegetable crops, canning crops, as well as larger wheat crops.

We have all types of mountain recreational facilities in the State—summer and winter recreation. We have some of the best ski areas in the country. A favorite attraction, which I am sure some of you will see, is the Air Force Academy in Colorado Springs. The Academy now is on 17,600 acres of land. Recently, I had an opportunity to go back to the Naval Academy. They are housed on 400 acres. We really spread them out in Colorado Springs. I think you would enjoy seeing that area.

We again want to welcome you to Colorado and sincerely hope that you will come back later and spend a wonderful vacation in our Columbine State.

PERFORMANCE STANDARDS—A JOINT VENTURE OF INDUSTRY AND GOVERNMENT

by J. P. Eberhard, *Director, Institute for Applied Technology, National Bureau of Standards*



My father was a minister and since Reverend Searles read a passage from the Bible this morning, I thought it would be appropriate if I did, but I wanted to make it appropriate for my talk and my talk is about performance standards. Interestingly enough, the Bible is an ancient source of performance standards.

About 700 years before Christ, in fact, King Lemuel of Israel laid down one of the all-time classics of performance standards. We can read in Proverbs, Chapter 31, the following performance standards for a good wife:

> She will do him (her husband) good and not evil all the days of her life.
>
> She seeketh wool, and flax, and worketh willingly with her hands.
>
> She riseth also while it is yet night, and giveth meat to her household, and a portion to her maidens.
>
> She stretcheth out her hand to the poor; yea, she reacheth forth her hands to the needy.
>
> She openeth her mouth with wisdom; and in her tongue is the law of kindness. . . .

This addresses itself to today's technology. I read this to my wife and she was not impressed. I call this an early classic of performance standards, because it says nothing about the physical appearance of such wife; it does not say how she is to help the poor or how large a portion of meat she is to give to her maidens; but it does sug-

gest that her performance will be characterized by willing work, good actions, and kindness. These latter criteria for performance have been universally recognized as desirable and, just as universally, philosophers have recognized the difficulty of measuring such performance.

These characteristics of performance standards are still good guides for us today in the development of what I am concerned about engineering performance standards. They should describe the functional requirements or effectiveness levels of materials, components, assemblies or systems, but not prescribe how these requirements are to be met in terms of engineering design.

In our Institute for Applied Technology, we are not responsible for developing performance standards for wives (although we come pretty close because Mac and some of his boys are working on some standards for women's dresses), but we are interested in advancing the Nation's ability to write performance standards for buildings, for information systems, for electronic instruments, for computers, and a variety of other areas, including weights and measures. Under new legislation now pending before Congress, as Dr. Astin indicated earlier, we may be asked to provide the technical knowledge needed to write performance standards for automobile safety, possibly for "fair packing and labeling" standards, and, hopefully, one of these days, performance standards for what constitutes a good city.

I thought it might be useful, therefore, to spend a few moments exploring with you what we mean by performance standards, the difficulties inherent in trying to measure true performance, and my view of the relationship—and I must stress it is my view—between government and industry in developing and using performance standards.

Almost every conference on research which I attend these days gets around to discussing the need for performance standards of some sort. An industry association will likely have a committee for looking into a voluntary set of performance standards for the industry's product; a consumer group will likely demand that higher performance standards be developed in some area to help raise the quality of manufacturing; and almost every government agency is advocating performance standards in its area of concern. Even that august body, the United States Senate, is presently considering performance standards relating to the ethics of its members.

I would like to make several different attempts to share with you some of the thinking we have done about what the term "performance standards" means. The first attempt relates to what we call the link between "user needs" and performance standards. The recognition or analysis of user needs is the first step required for developing a true performance standard when we speak of engineering standards for any product exchanged in the market place. We have pretended for a long time now that it is possible to write standards for use in build-

ing codes or to concern ourselves about safe automobiles by specifying the engineering properties of such products. We know now that we need performance standards in these areas, and that we will need to look at the user requirements in order to do that.

In the building area, this means more research to explore how buildings are related to man's requirements: what functional, physiological, and psychological needs of man is the building expected to meet. Our knowledge in this area is extremely limited. Building research has been dominated by engineers, physicists, and chemists who concern themselves with the basic properties of the materials or equipment that went into the buildings, but very little with the basic needs of the people who would use the buildings. We are going to need a much larger contribution from the social scientists to building research if we want to get at true performance standards in the next few years.

Once it is possible to state the user requirements for a product or system, there are several other stages of development. The next stage is performance criteria—those characteristics of the product that are observable and capable of being isolated. These need to be identified and then appropriate test methods for evaluating them need to be developed. Once performance criteria and test methods are available, then performance specifications can be written. Normally, only after the specifications have been tried is one of the procedures begun for reducing the knowledge and practice to a standard. Thus it is clear that performance standards require a long period for their successful development.

Another aspect of performance standards that needs to be understood is that there is a spectrum of complexity to which they can be related. It is possible, for instance, to talk about performance standards for bathtubs and to do so by referring only to the required properties of the materials of which the tub is made. I would not call this a performance standard, but some people do. The next level of complexity would be to describe the performance requirements of a bathtub by including the tub in a broader performance requirement for the total plumbing system in the house. At this stage, its performance as one component of a larger system becomes important.

The next level of complexity would be to describe the plumbing system for a house as before, but to include the required functional and physiological requirements for the people who will use the system. However, in my view, we are still short of a true performance standard as long as the requirements are related to a specific technological solution, and plumbing is a specific technological problem. Plumbing is based on water and gravity essentially. This is only one possible way of solving the technological problem to which the bathroom addresses itself. A true performance standard, therefore, states the user requirements and the needed performance levels without reference to

existing technological solutions. When we are able to do this, by and large we make it possible for industry to develop new innovations.

Let me illustrate. If a building code says that the walls of a house "shall be 2 x 4's, 16 inches on center," then it is a very narrowly drawn specification standard because 2 x 4's is a specific size (or it used to be) for a piece of lumber. Sixteen inches on center is a specific distance apart. That is freezing technology. It has been frozen in many building codes that way for a long time. If it were possible to state in a building code that the walls of a house should have certain structural properties, acoustical properties, heat-transmission characteristics, surface properties, etc., and then to be able to measure the performance of entire wall systems with respect to these properties; and if the properties and tests have been based on the needs of the humans who will live in the houses (as contrasted with the way that existing wall materials now perform), then we would have a true performance standard. Industry could develop walls of aluminum or kraft paper, or even green cheese and, so long as the wall met the performance standard, it would be acceptable. Under such conditions, innovations would likely come forth in large numbers and the resultant benefit to the public would be enormous.

Performance standards then may be used to measure the functional level of effectiveness of materials, components, assemblies and/or systems.

They have as their primary input a determination of the interaction of the product for which the standard is intended with the requirements of the human beings who will use it. The requirement for drivers to be able to have good visibility under all driving conditions would be an indication of an automobile safety performance requirement.

Performance standards may also describe the interaction of products with natural forces like rain or gravity. The requirement that the roof of a house be free of leaks would be such a requirement.

Performance standards will often describe the requirements for the interaction of products with other systems. For example, a tire safety standard might well describe the interaction capability of the tire with various road conditions.

The important thing here is that performance standards do not dictate design solutions. They would not say how an automobile was to be designed in order to provide better visibility for the driver, or how a roof was to be constructed in order to avoid leaks, or how a tire was to be made to minimize skidding on wet pavement. These design solutions are best left to the skill and imagination of industrial engineers and product designers. Good performance standards, however, will provide an equitable way of judging between alternative designs or engineering solutions.

Because they provide a basis for sound or equitable judgment between alternatives, performance standards should be a tool of governments at the Federal, State, or local level when matters of public health, safety, or welfare are involved. Governments need not develop these standards, but I would argue that they have a responsibility, as a public trust, to assure the development of adequate performance standards and associated test methods in those areas which involve health, safety, and welfare. I believe, in fact, that true performance standards are the most democratic basis we have for assuring the public interest while allowing private enterprise to seek alternative design or engineering solutions through competition.

I have sometimes been surprised at the way that private industry has resisted this shift to performance standards. It is not too surprising if a company that produces a single building material resists changing a building code that gives it a certain amount of market protection. But there are not many one-material companies of any size left. Most of them have diversified into new areas, and most of them claim to be doing research. Outdated specification type building codes, therefore, also make it difficult for this same company to introduce its own new innovations. I am confident that in the next few years most companies will come to realize that free competition in the market place is to their own long-term interest. As this begins to be realized, there will be even more interest in developing good building codes based on true performance standards, and our Institute for Applied Technology in the National Bureau of Standards wants to help in this area.

Well, what does all of this mean to those of you who are involved in weights and measures? I think it means that you should not be sitting there dreaming with me about performance standards for buildings or automobile safety if you are not willing to look at yourselves. I think it means some changes for you in the next few years, just as it means changes for the rest of our friends in industry and government. You have been in business for a long time, longer than the National Bureau of Standards. During that time, the science and technology of measurement has gone through many changes. Only a century ago, we were lucky if we could get a bushel in New York to equal a bushel in Pennsylvania. Now your calibration tools are so accurate that you probably exceed the practical ability of the normal small businessman or his customers to fully utilize the accuracy you can demand of his weights and measures. I know we do in the Bureau. I doubt that extremes of accuracy very often come into your practice. But these are areas in which you are involved. Since I am a novice in your area, I can speak frankly. So let me.

I read last night the proposed standard for milk bottles. It seems to me that as a consumer, I am not so much concerned that the container in which I buy milk be held to tolerances of nine-tenths of a

cubic inch for a quart, but I am interested in getting equal quantities from whichever producer I decide to buy. My performance requirements, therefore, are not very precise when I say equal quantities, but science and technology have made it possible for you to require precision of the industries with which you deal. When I see your proposed amendments to tolerances on the average capacity of milk bottles, the following sort of naive questions come to my mind:

> Why milk bottles? I hardly see them any more. All my milk comes in paper containers. What are these fellows trying to get at here? It must be that some people buy milk in bottles and that there is a tendency to skimp on the bottle size by some producers. Or maybe it is that the dairies are complaining about the bottle manufacturers, because a little more milk in a couple of thousand bottles could make a difference to a diary when it does not make any to me as a consumer.

I honestly do not know the issue here, and I purposely did not ask Mac Jensen about this before I wrote this, because I wanted to make a naive approach. I wanted to be naive because I wanted to guess what performance purpose was served here in order to get you to think about performance standards and weights and measures laws. You will remember that I suggested earlier that governments should set true performance standards based on user requirements and let industry do the engineering to find solutions. My understanding of your procedures is that it does this by design. Your performance standard is basically that milk bottles be uniform in size, and you leave it to industry groups to determine what uniformity tolerances it would be possible or desirable to obtain. The caution I would suggest is that each section of your model laws take pains to point out the underlying performance standard implicit in that law in order that the specification which emerges or the design requirements which grow out of the performance standards do not become gospel, because this gospel tends to freeze the technology at a particular point of time.

Well, from what I have seen of your organization in the last few years that I have been associated with the National Bureau of Standards, I am certain that you are a dynamic one. You would have to be for as many of you to get to Denver under these circumstances. I know you will want to do the best job possible, given the present state of science and technology. That is why I have tried to give you some feeling for an important direction in which I think we are going with engineering standards, and that is the direction of the development of true performance standards. I wish you well in the remainder of your meeting, and I thank you for inviting me to participate this morning in your Conference.

ADDRESS

by J. F. True. *State Sealer, Division of Weights and Measures, State Board of Agriculture, Topeka, Kansas, and Chairman, National Conference on Weights and Measures*

It is, indeed, a happy privilege as Chairman of the National Conference on Weights and Measures to extend to all of you present today, a cordial welcome. The officers and committees welcome all of you to this 51st National Conference. It is our desire that this might prove to be one of the most worthwhile Conferences sponsored by this group. It may be significant as we start on our second 50 years that this Conference is being held in Denver. This is now a truly National Conference, and I believe it will be helpful to weights and measures if the Conference can be held away from Washington, D.C., at times. In our present-day fast-moving world, no jurisdiction can go it alone. We must support an association to obtain information, to promote research, and to receive inspiration.

I hope that you have read the program. It has been very carefully arranged and includes an impressive group of speakers. The speakers have put much effort in preparing their addresses and many of them have traveled many miles. Their messages will be interesting and full of information. I hope we will give them our undivided attention at all sessions of this Conference.

This is the 18th National Conference on Weights and Measures that I have attended. It has been my privilege and pleasure to become well acquainted with weights and measures directors from most of our States. Many of them have been most helpful in developing our own program. Weights and measures always has room for improvement; all segments of work are demanding new and better methods. We want to encourage industry to develop more accurate and faster weighing and measuring devices. We must not stand in the way of progress while seeing that equity prevails. Automation is necessary in today's marketplace. If it were not for automation, prices of commodities at retail outlets would be substantially higher than they are now. While we may scream at the cost of things, yet the American wage earner spends a smaller percent of his paycheck for the necessities of life than anywhere in the world.

This has been the first year for Handbook 44, 3rd Edition, and the Examination Procedure Outlines that go with it. Some revision may be in order and constant study is necessary to improve and make this handbook useful to both weights and measures officials and all industry. Mac Jensen and his staff have been very helpful with training schools in many States. A number of States have their own training schools

for county and city inspectors. This is necessary. The inspector in the field is the one who builds the weights and measures image in the eyes of the public.

The success of this Conference is reflected in the uniformity or lack of uniformity that exists among the States. With our present speed of transportation and travel, complete uniformity is more important than ever. At the last Annual Meeting of the National Scale Men's Association, they discussed the registration bonding, or other regulatory procedures regarding scale servicemen. In many other fields we lack uniformity.

In the past year, it has been my privilege to attend the meetings of the Southern Weights and Measures Conference, Western Weights and Measures Association, and the Midwest Region. All of these meetings were excellently planned, and I was glad to attend.

Some of the standing committees held meetings since the last National Conference. You were sent their tentative reports in the folder you received announcing the 51st National Conference on Weights and Measures. You have all been encouraged to express your views, and I hope you attended their meetings yesterday. These committees are to be complimented on their deveotion to purposes and on their efforts to make these comittee reports of real value to all of our weights and measures officials. We want to thank the members of industry for their help and guidance to the Conference committees.

It is impossible at this time to give credit to, or even mention, all of those who participated in National Weights and Measures Week. You will hear much more about this from the Committee on Education and, here again, industry has not only cooperated, but it has actually given leadership in helping promote National Weights and Measures Week. It is part of our responsibility to tell the public about our work so that we can better serve. Education is a slow process and requires year-round work with additional emphasis at the time of Weights and Measures Week.

We are begining this morning the formal proceedings of this 51st National Conference. The success or failure of this Conference is now up to you. With your full participation it will be a success for all of us. Without your full participation, it will only be partly successful. If you are not already familiar with the zeal and determination of our Executive Secretary, Mr. Mac Jensen, I am sure you will be acquainted with it before the Conference is over. The times for all Conferences are listed in your program. There is plenty of time for discussion or small personal conferences. Will you please participate fully throughout the Conference. I would like to close these few remarks with this quotation from the late Charles Schwab of U.S. Steel:

> We are salesmen every day of our lives. We are selling our ideas, our plans, our enthusiasm to those with whom we come in contact.

AFTERNOON SESSION—TUESDAY, JULY 12, 1966
(M. JENNINGS, *Vice Chairman,* Presiding)

THE PLASTIC BOTTLE FULFILLING PACKAGING NEEDS

by W. T. CRUSE, *Executive Vice President, Society of the Plastics Industry, Inc., New York, New York*

It's an honor for the Society of the Plastics Industry to have a representative address this 51st National Conference on Weights and Measures.

The Society of the Plastics Industry (SPI) is the trade association for the plastics industry, encompassing over 1,300 plastic raw materials manufacturers, processors, and fabricators, as well as plastic fabricating machinery manufacturers.

The subject for this talk, the plastic bottle, is one of the fastest-growing parts of our industry. It might be best to first define some parameters. The term "plastics" is generally defined as "any one of a large and varied group of materials consisting wholly or in part of combinations of carbon with oxygen, hydrogen, nitrogen, and other organic and inorganic elements which, while solid in the finished state, at some stage in its manufacture is made liquid and thus capable of being formed into various shapes, mostly through the application either singly or together of heat and pressure."

While plastics is a generic term for materials, there are two basic classifications: thermoset plastics and thermoplastics. Thermoset plastics are those which are set into permanent shape when heat and pressure are applied to them during forming. This category of plastics material is not used in the manufacture of plastic bottles.

The thermoplastic family of materials is used in the manufacture of plastic bottles. These materials become soft when exposed to sufficient heat and harden when cooled, no matter how often the process is repeated.

Most plastic bottles on the market today are manufactured of thermoplastic materials *by the blow molding process.* Basically, blow molding consists of extruding a hollow tube of the molten plastic material (called a parison) which is clamped between mold halves and inflated by air. The material is cooled in the mold to retain the desired shape of the mold and then ejected.

How did the plastic bottle start? As recently as the mid-Thirties, there was no commercial blow molding of plastic containers or bottles.

About 1937 an experimental group investigated the feasibility of blow molding new thermoplastic materials including cellulose acetate and styrene. Experimental work brought out the unique personalities of each of the thermoplastics. Gradually, mechanical methods were devised to handle these new materials.

This early work demonstrated that it was feasible to produce plastic containers, tubes, and bottles. At that time, however, the price of basic thermoplastic resins was so high that it discouraged commercial application.

During World War II, this experimental work had been carried further sufficiently to enable small containers for water purifying tablets to be produced for the Army Medical Corps field kits. This was accomplished in early 1943. The containers were lightweight and particularly desirable because they were durable.

Toward the end of World War II, simple household articles such as decorative Christmas tree balls were being made in the United States from blow molded acetate and styrene.

After World War II, low-density polyethylene became available to the infant plastic bottle industry. Although the cost of the raw material was still high, polyethylene offered many advantages that the older thermoplastics lacked. It was not brittle, it retained its resiliency even after molding, it had flow characteristics which permitted a new freedom of design for the shape of containers. Early containers blown of this material were put to use as carriers for acids and other industrial products where durability was extremely beneficial. By 1946, technology for blow molding low-density polyethylene had advanced considerably and plastic containers were finding their way to markets in limited quantities for special applications.

Government regulations as set by the Interstate Commerce Commission were rewritten to encompass these new containers. This alone required tremendous testing to show Government agencies that the plastic containers were safe and, in most cases, superior containers to those made from conventional materials.

Great commercial impetus for the plastic bottle came when the first squeeze bottle was introduced in 1946. Dr. Jules Montenier developed a liquid deodorant which he wished to be applied as a spray. He had developed the spray nozzle, but needed a flexible or bellows-type container to hold the liquid and force it through a spray applicator. He approached the group which had done the experimental work on plastic bottles. This group developed an oval-shape, two-ounce, blow molded polyethylene container to meet his needs. This became the first commercial plastic squeeze bottle. Within two years, five million plastic squeeze bottles of Stopette deodorant had been sold.

Repeated mention has been made of thermoplastic material used for plastic bottles. Today, the prime resin for bottle production is polyethylene in its three density ranges: low, medium, and high. How-

ever, each thermoplastic resin brings to the plastic bottle is own unique characteristics. These characteristics are studied in light of the distinctive qualities of the products to be packaged in the plastic bottle. In addition to polyethelene, at present, polypropylene, polyvinyl chloride, and polystyrene are being used.

Other plastics which have been successfully blow molded are acrylonitrile butadiene styrene polymers, cellulosics, ionomers, modified acrylics, phenoxies, polyamides, polyesters, polycarbonates, and polysulfones. Resin research continues to create plastic materials that will serve specific end-use applications better, or to meet specific requirements. For example, new resins are continually being developed which are generally accepted for use in food packaging according to the requirements set by the Food and Drug Administration.

Statistics.

Let's review the statistics of plastic bottles manufactured (fig. 1). SPI's Plastic Bottle Division yearly contributes monies to the Bureau of the Census to help underwrite the expense of the Current Industrial Report, Form M30E Plastic Bottles. Undertaken slightly more than a year and one half ago, the Bureau of the Census shipment statistics for plastic bottles indicate that for the year 1965, 2,606,379,000 bottles were produced. This is the most current report. Divided into the end use categories for which the bottles were manufactured, the classifications are as follows: In the household chemical field including bleach and detergent containers, 1,608,175,000; industrial chemicals and specialties which would be paints, varnishes, battery acid containers, etc.—77,103,000; in the toiletries and cosmetic field including shaving preparations, hand, face and body lotions, and the like—576,513,000; in the medicinal and health classification, drug products, vita-

mins—257,920,000; in the automotive and marine product field, hydraulic fluid, antifreeze—motor oils—23,988,000; and in the field which is of particular concern to you, food and beverage—62,680,000 bottles were produced.

Within the Society's Plastic Bottle Division, there is a Food Bottling Committee which directs its activities to working with agencies whch assemble and disseminate information concerning various local and national requirements and practices which apply to the manufacture and distribution of plastic bottles for food and beverage packaging. The plastic milk container falls in this classification and projects its own interesting growth story in recent years. In 1961 and 1962 several dairies experimented with plastic gallon milk containers to test public acceptance. These early test markets were encouraging and a few dairies expanded their efforts to large scale commercial status. These pioneer dairies, located in Newark, New Jersey; Phoenix, Arizona; Newport News, Virginia; Chicago, Illinois, and Highpoint, North Carolina have witnessed a widespread expansion of their initial efforts. The pattern is as follows:

Year	No. dairies using plastic milk bottles	Year	No. dairies using plastic milk bottles
1962	3	June 1965	135
1963	4	Oct. 1965	200
Jan. 1964	12	Dec. 1965	280
June 1964	65	Feb. 1966	385
Jan. 1965	90	May 1966	500 in 39 States

These figures were supplied from the industrywide observations of a single firm participating in the Plastic Milk Bottle Program. The plastic milk bottles themselves may be obtained from a national manufacturer of plastic containers, a local custom processor, or the in-plant system whereby a blow molding machine is operated inside the dairy and containers are produced as they are needed.

All sanitary precautions are being taken in the fabrication and shipment of the bottles to assure that "*the nearly perfect food*" is protected from contamination at all times.

The new market for plastic milk containers has found us to be lacking in our knowledge of weights and measures requirements and we are, gentlemen, striving to improve our position in this field of knowledge.

It hasn't been easy. . . . First, there was the basic conflict between plastic milk containers and the regulations covering the packaging

of milk in bottles as outlined in Handbook 44. While it was obvious in the early days of the plastic milk bottle that the dairies were trying to fill the bottles to the top and give the consumer honest quantity, close check revealed that bottles manufactured by our member producers in some instances varied due to their own interpretation of Handbook 44.

Secondly, as this problem became more acute, an SPI subcommittee on weights and measures was formed. The SPI Weights and Measures team visited many dairies throughout the country and performed extensive, controlled plastic bottle filling trials on the conventional glass milk bottle fillers. Indeed, there were instances of overfill and underfill. We instituted a system of checks to be followed by our member manufacturers and last year petitioned the committee on weights and measures for a broader interpretation of Handbook 44 to include plastic milk bottles. Your committee essentially turned down our request for broader interpretation and looking back now, with justifiable reason.

Further consultation with the Office of Weights and Measures in Gaithersburg introduced us to Handbook 67 which covers the packaging of food as a commodity in a container. To eliminate confusion we changed our vocabulary from "plastic milk bottle" to "plastic milk container." We feel the contradiction in terms between bottle (H–44) and container (H–67) as applies to the plastic milk container has been cleared up.

Filling and Capping.

Most of the filling problems encountered in the early stages of the development program have been solved. In dairies where plastic containers are now in use on glass filling lines they move through filling and capping operations at conventional rates. So far as capping is concerned, a number of commercially available caps provide sanitary convenience and effective closure for the plastic containers presently available. Sanitary filling equipment specifically designed for plastic is being developed and some such fillers are available today. In addition to this, existing glass fillers with some slight modifications will convert so that plastics can be satisfactorily filled.

We believe that the functional plastic milk container with its novel and varied designs presents the American dairy industry with a formidable promotional tool which can help increase the per capita consumption of milk in this country, a goal which is most desirable to all of us.

The consumer has demonstrated a strong preference for goods packaged in plastic containers, including fluid milk. The fact that over 500 dairies are presently using plastic containers indicates it is already a strong factor as a package for fluid milk.

Members of the Plastic Bottle Division who produce plastic milk containers maintain individual company liaison as well as industry liaison with dairy filling equipment manufacturers. There is a mutual interchange of ideas to assure all parties concerned, including the dairy, that the filling aspect of the plastic milk container is constantly reviewed and perfection sought.

Although the plastic bottle industry is an infant in terms of more traditional packaging vessels, our member companies strive constantly to improve container quality and manufacturing techniques. We are working to perfect even better equipment and methods for the handling of plastic bottles by customers and we are concerned with improvement of the raw materials and supplies that our bottle-manufacturing members use in making and distributing their products.

A previous comment has indicated the almost overnight development of the plastic milk container as a packaging vessel. Consistent with the public good health, we ask your continued patience, restraint, and indulgence in reviewing our containers, safe in the knowledge that our goals are the same as yours. We wish to present the consumer with a clean sanitary container holding a full measure of milk.

We believe that rigid plus and minus filling tolerances are important, but the primary consideration of you weights and measures officials is to provide the public with proper measurement of filled containers. That being the case, we ask that you bear with us as we develop better and better filling controls.

Members of the Plastic Bottle Division of the Society, with technical and financial resources at their command, have assumed the obligation and responsibility to satisfy the technical and marketing requirements in the ever-improving packaging field.

FOOD PACKAGE LABELING—LEGAL REQUIREMENTS AND COMMERCIAL PRACTICES

by H. L. Hensel, *Law Department, Swift and Company, Chicago, Illinois*

You will note that the title of my talk is "Food Package Labeling—Legal Requirements and Commercial Practices." While this subject will not be ignored, I think it only fair to warn you that if you listen closely enough you may hear a comment or two on the subjects of uniformity and cooperation.

As a starting point, on the subject of legal requirements, let us consider a list of some of the laws with which the food industry must comply in order for the labels on its packages to be legally correct. Such a list would include:

(a) The Federal Food, Drug and Cosmetic Act;
(b) The Federal Meat Inspection Act;
(c) The Federal Poultry Products Inspection Act;
(d) Federal Acts dealing with particular foods such as margarine, butter, etc.
(e) State Weights and Measures Acts;
(f) State Food, Drug and Cosmetic Acts;
(g) State Acts governing meat and meat products;
(h) Special State Acts governing particular foods such as frozen desserts, margarine, etc.

All of these many laws have requirements concerning the labeling of food products. The general types of requirements covered fall into the following categories:

1. Giving the common or usual name of the product.
2. Listing the name and address of the manufacturer, packer or distributor.
3. Listing of ingredients.
4. Stating the net weight.
5. Showing the inspection legend if there is government inspection of the product.
6. Showing all the above information at the proper location on the package.
7. Stating all required facts in a conspicuous manner.
8. Giving all required statements for dietary products.
9. Giving all required statements for special ingredients such as artificial coloring, artificial flavoring, preservatives, etc.

Many of the above labeling requirements will be set forth in more than one law. For example, net weight requirements are found in State weights and measures laws, State food and drug acts, the Federal Food, Drug and Cosmetic Act, the Federal Meat Inspection Act, the Federal Poultry Products Inspection Act, State laws governing meat and meat products, and State and Federal laws concerning special foods, such as oleomargarine.

As a final dimension to the measurement of food packaging legal requirements, it should be remembered that most food manufacturers distribute their products nationwide. This means that food manufacturers must comply with all Federal laws governing their products, while at the same time they must comply with the laws of fifty States.

The above comments briefly summarize the legal requirements for labeling food packages. While it would seem that these requirements are more than ample to protect the consumer, additional Federal legislation on this subject is now pending in Congress.

The next question is, what is the commercial practice of the food industry concerning compliance with these requirements? Difficult though it may be, the rules are very simple. If at all possible, one

uniform label is designed that complies with all the requirements that affect that particular product in the jurisdictions where it will be sold. If this cannot be done on a uniform basis, nonuniform labels and procedures must be adopted. Sometimes this has meant designing a package only for sale in a given State. Sometimes it has meant that a given label which is going to be used in, for example, six States will contain information which is really only required in one of the six States. In a few cases it has meant that, because of nonuniform labeling requirements, a particular product is not sold in a given State.

Because of the complexity of the task of designing a uniform label, and the problems that arise when a uniform label cannot be used, I would like to discuss with you what is being done to increase uniformity in the area of package labeling, and secondly, how you can help with this problem.

In the field of weights and measures, the most important step towards uniform laws has been the adoption, by a number of States, of the Model State Weights and Measures Law. At the present time some 21 States have passed the Model Law, and approximately the same number have adopted the Model Regulation Pertaining to Packages. Each year, this number increases. It is hoped that many more States will follow this trend in the near future.

It should be mentioned that the mere adoption of the Model Weights and Measures Law and Regulations does not mean that they will never be changed. In a dynamic society, change is part of our way of life. Mr. Burditt will give you some additional comments concerning the Model Law and Regulations in his talk this afternoon.

One of the best examples of preserving uniformity, when a serious lack of uniformity was threatened, was the adoption of a model regulation on prominence and placement by your National Conference. Nothing would be accomplished by retelling the story in detail to all of you who know it so well from your own personal experience. It is, however, worth nothing that this experience is being cited time and time again as an outstanding example of how State officials, Federal officials, and industry representatives can work together and achieve both a desired objective and uniformity.

As a result of the cooperative work of industry with your Conference on the subject of prominence and placement of the net weight statement, industry has formed a permanent committee of those companies and trade associations concerned about weights and measures problems. Frank Dierson of the Grocery Manufacturers Association is Chairman of the committee and John Speer of the Ice Cream Association is Secretary. Two of the main purposes of this committee are (1) to keep industry advised concerning any proposed nonuniform weights and measures law, regulation or interpretation which affects labeling and (2) to work with State officials and officials of the National Bureau of Standards toward more uniform labeling laws, regulations,

and interpretations. This industry group has been very effective in helping to achieve these goals during the few years of its existence, and I believe it will continue to advance uniformity in the future.

Other steps towards uniformity have been taken in connection with food and drug laws. As of now, 33 States have adopted the Model Food and Drug Act. Also, steps are being taken to draft a uniform meat product law which could then be adopted as a model law by the States.

In addition to the above steps that are being taken, I would like to suggest at least two ways in which each of you can help achieve the goal of uniformity. If any matter comes to your attention for decision, and there is a known *uniform* law, regulation or interpretation, please follow the uniform law, regulation or interpretation. If the matter needs further clarification, refer it to Mr. Jensen of the National Bureau of Standards or your Laws and Regulations Committee and be guided by their recommendations. Problems concerning how to express the net weight statement have arisen in the past and have been successfully and uniformly handled in this very manner. In this regard, please remember that the smallest change from uniformity, such as how a word may be abbreviated, can change millions of acceptable uniform labels into unusable labels.

Secondly, I would urge you to restrict your labeling requirements to the net weight legend on the package, leaving other subjects to more appropriate enforcement officials. As an example of this point, it is my opinion that references on a label concerning the price to be paid for an item should not be regulated by weights and measures officials.

Before closing, I would like to make one comment concerning officials of the National Bureau of Standards. State officials and industry representatives both are fortunate to have men of great ability, such as M. W. Jensen and H. F. Wollin, in the Bureau of Standards. These men are in a unique position to help achieve progress and uniformity in the weights and measures field. Their assistance and cooperation is greatly appreciated by industry, and, I am sure, the State officials as well.

Appropriately enough, I have saved for the last my most important comment. It concerns the cooperation of enforcement officials, such as yourselves, with industry. With this cooperation, the food industry can operate on a nationwide basis even under nonuniform laws—without your cooperation such an operation would be almost impossible.

Let me illustrate how your cooperation is important:

1. Although many of you are from States that have not yet adopted the Model Law and Regulations, your interpretation of your law and regulations has been substantially the equivalent of that given to the Model Law and Regulations.
2. If a label is brought to your attention, which appears not to be in compliance with the law, an informal notice of this fact is

generally given so there is opportunity to correct any error that may exist.

3. Where changes in labels are necessary, a reasonable time is usually allowed for using up old labels.
4. Where honest differences of opinion have occurred, they have been resolved on a reasonable, practical basis. I cannot overemphasize the appreciation of industry for this attitude on your part.

We have had your 100 percent cooperation in the past. We very much need it in the future. As cooperation is only successful as a two-way proposition, I want to assure you that the food industry will do its part to make our relationship both effective and congenial.

THE PACKAGING INDUSTRY LOOKS AT THE MODEL LAW AND REGULATION

by G. M. Burditt, *Partner, Chadwell, Keck, Kayser, Ruggles & McLaren, Chicago, Illinois*

The Model Law and Regulation are virtually sacrosanct documents, and it is a pleasure and honor to be invited to speak to you on a subject which is so important to enforcement officials, industry and consumers. As more and more State legislatures adopt the Model Law, and more and more officials promulgate the Model Regulation, uniformity is the beneficiary, and as Mr. Hensel said this morning, uniformity is especially important to all of us. *Consumers* benefit, since they can be assured of uniform manufacturing procedures, quantity control and labeling requirements regardless of where the product is manufactured or sold. *Enforcement officials* benefit since uniformity promotes compliance and since a substantial body of judicial and administrative interpretations is quickly built up. And *industry* benefits since a package legal in one State is legal in others. So I join Mr. Hensel in thanking and congratulating you, including, of course, Mr. Jensen, his predecessor Mr. Bussey, and the other members of the staff of the National Bureau of Standards, for your work in drafting the Model Law and Regulation and securing their adoption in so many States.

Now with this kind of a background, I would *like* to be able to thank you again for your invitation to speak and to sit down! But my assignment today is to consider the Model Law and Regulation from the standpoint of those firms which are packaging commodities subject to the Models, and to suggest possible amendments for your consideration. My first comment, from industry viewpoint, must necessarily

be, however, that uniformity is the most important single factor to be kept in the forefront of any discussion of the Model Law and Regulation.

But uniformity is not necessarily promoted by rigid adherence to the status quo. For any law or regulation governing industries as dynamic as are those which sell consumer commodities must itself be dynamic and not static if it is properly to serve the public. And if the Model Law and Regulation are not dynamic, they will soon become models in name only. Therefore, it behooves the National Conference, as you have always done, to review the Models frequently and systematically to make certain that they are accomplishing the purpose set forth on the cover of both documents: "Uniformity in weights and measures laws and methods of inspection."

So let me make a few suggestions for your consideration, suggestions which are intended to promote *future* uniformity by keeping the Model Law and Regulation vital and viable.

Remedies.

First let me say a few words about two sections of the Model Law which set forth the remedies available to the enforcement official. Section 14 authorizes the director to issue

> . . . stop-use orders, stop-removal orders, and removal orders . . . whenever . . . he deems it necessary or *expedient* to issue such orders. . . .

Let me say that I am not personally aware of any instance in which a weights and measures official has based a stop-use or similar order merely on "expediency" as is authorized by the Model Law. Nevertheless, expediency is one of the tests provided by Section 14. It seems to me that both industry and enforcement officials would be better served by a statute which at least required the enforcement official to make a finding that public interest necessitated the issuance of the order. Indeed an order not based on the public interest but merely on expediency might well be unconstitutional and at the very least give a possible defense to such an order in cases which should not be defensible on procedural grounds irrelevant to the substantive issues involved.

Section 16 of the Model Law authorizes the director, again omitting words which are irrelevant for our purpose:

> . . . to arrest, without formal warrant, any violator

This same section authorizes seizure of packages without formal warrant which itself is a broad power but one which is probably justified since the action is against the goods rather than against a person. But the provision in the section which authorizes *arrest* without formal warrant is it seems to me too broad to justify leaving it in the Model. Again I am not aware of any instance in which this

section has been used or abused, which perhaps illustrates that enforcement officials, or perhaps attorneys general, also view this section as being too extreme.

I make these comments on Sections 14 and 16 only after serious consideration and reflection. As a member of the Illinois Legislature, I have tried to vote consistently against what I like to call "molly-coddling" bills, those which make it easier for the criminal, the delinquent, draft card burner, the cheat, to get along more easily in our society. This type of legislation which has friends not only in legislative bodies but also in our court system, I feel very strongly runs counter to our American tradition. But so also do statutes which authorize action based on expediency, or arrest and deprivation of liberty without a formal warrant. So I commend for your consideration a review of Sections 14 and 16 since extremism, even in the defense of honest weights and measures, is probably not justifiable.

Qualifying Terms.

The next subject which I should like to discuss is the use of qualifying terms. Section 26 of the Model Law and Section 3.9 of the Model Regulation prohibit the use of any term "such as 'Jumbo,' 'Giant,' 'Full,' or the like that tends to exaggerate the amount of commodity."

Now I can understand how a word like "jumbo" or "giant" might be misleading, although I would like to see a thorough consumer survey on this point before I am completely convinced. But the word "full" does not seem to me to belong in this list of prohibited terms. Let me give you a specific example. Two or three years ago, several food companies began marketing a liquid food product in exotic shaped jars and bottles which contained slightly less than a pint, some 15 fluid ounces, some 14 fuild ounces, and some as low as 13 fluid ounces. The exotic shape of the bottles precluded consumers from telling at a glance which of the jars were larger in volume. Indeed it was virtually impossible to differentiate the quantity in these jars from the full pint contained in competitors' jars. Accordingly, reputable firms who wished to hold the line at one pint, which was the size to which consumers had become accustomed, began marketing their jars with a flag which bore the words "Full Pint." The purpose of this quantity declaration was to enable consumers to see at a glance that the reputable firm's jars contained a full pint as distinguished from an ounce or two or three less than a pint contained in the exotic shaped jars. Use of the word "full" in this instance, it seems to me, promoted honest and fair dealing in the interest of consumers and should not have been absolutely prohibited by the Model Law and Regulation. You know, every once in a while one of my children brings home a test with a list of words, one of which does not match the other words for some reason.

The object of the test is to pick out the word which does not belong with the others on the list. It seems to me that such a test could be applied to Section 26 of the Model Law and Section 3.9 of the Model Regulation, and if it is applied, the word "full" would be deleted from these two sections. An alternative suggestion would be to permit the enforcement official to allow use of the word "full" when in his opinion public interest was served by use of the word "full."

Pricing.

Next let me make a few comments concerning sections of the Model Law which relate to pricing. Mr. Hensel, this morning, listed the many laws with which a seller of consumer commodities must comply. These laws are, of course, enforced by numerous different agencies. Right now, in Illinois, we have an interim legislative commission entitled the Food, Drug, Cosmetic and Pesticide Laws Study Commission of which Mr. Hensel, incidentally, is one of the public members, which is reviewing all of our State's laws in this area. We have found laws enforced by the Department of Public Health, the Department of Public Safety, the Department of Agriculture, the Department of Education and Registration and of course by several divisions within these departments. If we are to avoid overlapping jurisdiction, duplication of effort, unnecessary expense to the taxpayer, and unwarranted burdens on industry, it is important that specific lines of authority be described in our statutes and regulations.

In this regard, it seems to me that matters relating to pricing and price labeling, should be assigned to State and local law enforcement officials, such as State's attorneys and attorneys general, and to State agencies analogous to the Federal Trade Commission rather than to weights and measures officials. By this, I do not in any way mean to de-emphasize the importance of pricing regulations; indeed I believe their importance would be emphasized by centralizing enforcement in one official and placing the burden squarely on that official to make certain that laws are compiled with by everyone. I am sure you know from your own experience that any time two different departments within a State or two different officials within a State are given jurisdiction over the same subject matter, enforcement tends to be more lax than it is when clearly defined jurisdiction is assigned to one department or to one official.

Section 27 of the Model Law requires random weight packages to bear on the outside of the package "a plain and conspicuous declaration of the price per single unit of weight, measure or count." Section 31 of the Model Act prohibits the misrepresentation of a price, prohibits representation of a price in any manner calculating or tending to mislead the purchaser, and requires fractions of a cent in price labeling to be prominently displayed. Now, no one can argue that misrepre-

sentations of price should be prohibited, but it does seem to me that officials other than weights and measures officials should be charged with the responsibility of enforcing these provisions.

Supplementary Declarations.

Section 3.7.1. of the Model Regulation permits a supplementary declaration of weight, measure or count, provided, among other things

> . . . any such supplementary declaration shall be neither in larger size type or more prominently displayed than the required quantity declaration . . .

But frequently, a consumer is far more interested in a supplementary declaration than in the primary declaration, and in such cases it is customary for industry to put the supplementary declaration in larger size type. For example, a consumer is more interested in "4 waffles" than in "6½ ounces net weight;" or in "8 slices" than in "8 ounces net weight." In such instances, it is, of course, possible that "4 waffles" or "8 slices" might be considered the primary declaration, but I would suggest that Section 3.7.1 be amended to give the enforcing official authority to permit what would normally be considered to be a supplementary declaration to be larger than the primary declaration if the public interest is thereby served.

Section 3.7.3 of the Model Regulation requires that a declaration of quantity in terms of count be supplemented by a declaration in terms of weight, measure or size

> . . . unless a declaration of count alone is fully informative to the consumer

and Section 3.7.4 requires that a declaration of weight or measure be supplemented by a declaration of count or size

> . . . unless a declaration of weight or measure alone is fully informative to the consumer.

These words "fully informative to the consumer" are perhaps not quite as clear as they might be. They are the kind of words which lead to differences of interpretation, and to that extent, impair uniformity. One official might well take the position that a declaration of weight is "fully informative to the consumer" and adhere to the strict meaning of these words. Another official, on the other hand, might decide that the declaration is not "*fully* informative" and that a supplementary declaration is therefore required. Here is another instance in which "public interest" might be written into the Model Regulation to the benefit of all parties.

Nonconsumer Packages.

A great deal of effort has been put into the wording of Section 6. 8. 1 of the Model Regulation over the last few years. This is the section which relates to "industrial-type" or "nonconsumer type" packages.

The present wording is still perhaps not quite as clear as it could be For example, are "free samples" exempt, as they probably should be, and if so—what packages qualify as free samples? This section is something of a Pandora's Box, but perhaps the lid could be lifted just a little for more examination of the contents without allowing anything to escape.

Shrinkage.

No talk on the Model Law and Regulation would be complete without a few comments on the very important and very controversial subject of shrinkage. Section 8. 2 of the Model Regulation permits variations from the declared weight or measure when caused by ordinary and customary exposure to conditions that normally occur in good distribution practice and that unavoidably result in change of weight or measure.

> . . . but only after the commodity is introduced into intrastate commerce:

which is defined as

> . . . the time and the place at which the first sale and delivery of a package is made within the State, the delivery being made either (a) directly to the purchaser or to his agent, or (b) to a common carrier for shipment to the purchaser . . .

This section also requires that

> . . . so long as a shipment, delivery or lot of packages of a particular commodity remains in the possession or under the control of the packager or the person who introduces the package into intrastate commerce exposure variations shall not be permitted.

This position appears to be in conflict with the Federal rule which requires that the package bear the stated quantity at the time it is introduced into interstate commerce, but permits shrinkage which unavoidably results in change of weight or measure after the product is introduced into interstate commerce. Manufacturers have an immense, and indeed impossible, burden in trying to overpack to meet all possible conditions of shrinkage.

There is no panacea for this difficult problem. A uniform Federal and State rule would, however, be most desirable and I sincerely urge for your consideration incorporation of the Federal rule into the Model Regulation.

One method fo alleviating this difficult problem at least for some parts of the food industry has recently been suggested. A number

of viscous or semisolid products have customarily been sold by liquid measure. These products may shrink through loss of air or for other reasons, but they do not lose weight. Therefore, it seems to be becoming more and more prevalent to label such products by weight rather than by liquid measure. This change in the method of sale is probably authorized by Section 25 of the Model Law and Section 3.2 of the Model Regulation, particularly if State officials are sympathetic to the difficult problem which faces industry.

Prescribed Units and Fractions.

Section 3.5 of the Model Regulation requires that a declaration of quantity be expressed in terms of the largest whole unit of weight or measure. An alternative to this requirement has been suggested, I believe by Mr. D. W. Leeper of H. J. Heinz Company. Mr. Leeper suggests that weight declarations of ten pounds or less, or one gallon or less, be in ounces and fractions or decimal parts of an ounce unless the quantity declaration is accompanied by a declaration of both the price per unit of quantity and the total price. This "All Ounce" system has the advantage of facilitating price comparisons, and is included in S. 985 which was recently passed by the United States Senate.

One other suggestion concerning the declaration of quantity should be made in regard to the binary submultiple system—a term which Mr. C. D. Baucom introduced me to about ten years ago. Section 3.6 of the Model Regulation provides that

> Declarations of quantity may employ common fractions or decimal fractions

and requires that a common fraction be in terms of halves, quarters, eighths, sixteenths, or thirty-seconds and be reduced to its lowest terms. Frequently a manufacturer finds it necessary or desirable, for example because of the size of servings, or for recipes or for various dietary reasons, to package a food in fractions of an ounce which are not part of the binary submultiple system. In such instances, the manufacturer is forced to show on his label for example, "6.33 ounces" rather than "6⅓ ounces," even though the latter may be more meaningful to most consumers. I realize that the binary submultiple system had valid and justifiable reasons for its original inclusion in the law, but those reasons are no longer valid as is evidenced by the provision authorizing use of the decimal equivalent of fractions which are not binary submultiples. So even though it was historically sound, and even though I love to say "binary submultiple," it seems to me that public interest in the simplification of quantity statements should lead you to consider amending Section 3.6 to relegate the binary submultiple requirement to the archives and to permit declarations at least in thirds of an ounce.

Prominence and Placement.

Finally, I should say a word about prominence and placement which are so thoroughly covered by Section 26 of the Model Law and particularly by Section 6 of the Model Regulation. You will be glad to hear, both for time and other reasons, that I have no suggestions for amendments. Section 6 is a perfect example of how consumers benefit when enforcement officials and industry cooperate to reach a desired goal. The Committee on Laws and Regulations of the National Conference—Mr. Barker, Mr. Littlefield, and Mr. Lewis as Chairmen, and Mr. Goforth, Mr. Gustafson, Mr. Jennings, Mr. Lyles, Mr. Turrell, and very importantly Mr. Bussey and Mr. Jensen have made a great contribution in their work on Section 6, and the Industry Committee on Weights and Measures under the able chairmanship of Mr. Frank Dierson, and with Mr. James Bell and Mr. Harvey Hensel as vice chairmen and Mr. John Speer as secretary also deserves our deep appreciation. If there is any way in which the Industry Committee can be helpful—or any way in which I can personally be helpful as a State legislator who has had the experience of shepherding a model food bill through the legislature—we are of course at your disposal. The reciprocal cooperation of the Industry Committee and the National Conference, as Mr. Hensel said this morning, will inevitably keep the Model Law and Regulation vital and viable in our mutual endeavor to serve consumers.

ENFORCEMENT OF STATE LAWS AND REGULATIONS

by J. H. Lewis, *Chief, Weights and Measures Section, Washington Department of Agriculture, Olympia, Washington*

I must admit that it was with a great deal of reluctance and no small amount of procrastination that I accepted the challenge to present this paper on a subject such as this. When Mr. Jensen suggested I discuss one subject of intelligent enforcement of the Model Law and Regulations, my immediate reaction was "that's not for me." However, when I went to Mr. Webster's dictionary, I found that *intelligence* was defined as "the ability to learn or understand from experience." I said, "Man, that's for me." For if anyone ever had a great deal to learn in weights and measures it was your speaker. I took a new look at the possibility, a new evaluation of what I had learned during my association with weights and measures and

felt that possibly I would have something worthwhile to share with you.

Please pardon the personal reference but, as a background, I will point out that, at the time I took my present position in November of 1958, our jurisdiction was in the throes of formulating new weights and measures legislation to be presented to the legislative body in less than 60 days. Many hours had been spent in conference, drafting and redrafting, and in numerous meetings with industry, local weights and measures people, and many others. All seemed to have different opinions about what should or should not be included in a weights and measures law.

A call for help was made to the NBS Office of Weights and Measures and it came in the person of Mr. Jensen. This resulted in the scrapping of our cumbersome drafts and, after burning a little midnight oil, the Model State Law on Weights and Measures, with a few minor changes, was slipped into place. With the help of favorable legislative committees, the Bill was guided through the Legislature in the spring of 1959.

The sense of pride in our new law quickly gave way to realization we had a responsibility to promulgate the regulations which the new law required. In this area also help was solicited from the Office of Weights and Measures and resulted in the adoption of the Model State Regulation Pertaining to Packages in March 1960. These facts are recited only to show that it has been our privilege to work with these tools for almost seven years.

I would not intimate that we in the State of Washington had a more difficult time enacting a new statute than any other jurisdiction. As a matter of fact, it seemed the opposition melted and many objections were overcome by the magic words "Model Law." This did not eliminate, nor has it yet eliminated, the need for public education and self enlightenment in the proper administration of these tools of enforcement. Training personnel to assure uniform interpretation in the field became the first order of business. To meet the inquiries of different industries necessitated meetings, conferences and sometimes pleasurable luncheons to attain a meeting of minds on interpretation of sections in question. It seems this is a never-ending process. Personnel must be brought together at regular intervals to review policies, procedures and practical application of what the law demands. Our ever changing world about us puts great demands on our ingenuity and creative imagination to keep up with it. Even a "model" law must be updated frequently. The authority to promulgate rules and regulations provides a means to quickly and easily meet changes in merchandising methods that could not be foreseen when the law was enacted. Only through such rules and regulations can we enjoy the flexibility needed to meet the changes we encounter. The importance

of this mobility cannot be over-emphasized. This however warrants a word of caution as it is a thing that can be overdone. Too many regulations have a tendency toward confusion and even frustration if profusion develops into contradictions.

Beyond a doubt our predecessors, who have met through the years as the National Conference on Weights and Measures, would be thrilled with the attainments exemplified in the current Model Weights and Measures Law and Regulation. It thrills me to observe the progress made in the few short years it has been my pleasure to be in the weights and measures field. I don't believe there has ever been a finer spirit of cooperation between industry as a whole and those of us charged with the responsibility of enforcement. The recent development of the prominence and placement sections of the Model Regulation stands out as a memorial to such fine cooperation.

It is one thing to theorize on enforcement and another thing to make a practical application of the cold, hard words that make up a law or regulation. We have all met those who would lead us to believe they enforced the letter of the law but in actual practice it has proved otherwise. It is my firm belief the laws are established for the purpose of meeting the most demanding of situations and are meant to be tempered with justice and practicality. This does not mean we should bend the law to meet personal whims or demands from pressure groups, who have special interests, at the expense of uniform application. It means that each case and each situation commands an analysis of the factors involved to determine the proper course of action. If the conditions demand such action the full extent of the law is available. We have been advised that under the law an offender has the right to know what the law requires of him. This is in disagreement with the often used quote that "ignorance of the law is no excuse." While this may be true we have found that in most instances when the requirements are made known cooperative compliance has resulted. The term "in most instances" is used advisedly because there are those who have no intention of complying until they are forced to do so. For these few, laws and regulations might be strictly applied.

I do not hope to intimate here that the State of Washington has achieved the ultimate in enforcement. Frankly, many times I feel we are far from it. Nevertheless we do enjoy reasonable compliance within our jurisdiction. I would say the greatest single contributing factor in this achievement is the fine cooperation and rapport we have with the local jurisdictions.

Our law requires that each First Class city of 50,000 population or over must maintain their own Weights and Measures Program. We have four such cities in Washington and they each contribute toward the enforcement goal. This is done by carrying out an active program in their respective jurisdiction, attending our statewide conferences or

training sessions and responding quickly and efficiently when called upon to assist in an investigation, complaint or infraction. Many of the local personnel have been in weights and measures much longer than I and their counsel and advice has frequently helped over some rough spots. I am pleased to say that two of our cities currently have the Model City Ordinance in effect and the City of Seattle is running the gauntlet of public hearings and will soon adopt it. Therefore we basically have the tools. Now, it is a matter of using them to accomplish the desired end.

What is the desired end and how do we accomplish it? However trite, I'm sure each of us would agree the desired end is "compliance" with the requirements of the law and regulations. To accomplish this end is the task to which we have all dedicated our best efforts.

Planning plays no small part in effective enforcement. We have recently heard much of the terms "long-range" or "multiyear" planning. This involves projection of programs, budget, personnel and personnel training into the future. In each of these areas we must have goals that become targets toward which we direct our efforts.

It has been said that one of the most challenging characteristics of the American industrial and economic system is the persistency of change. New marketing techniques, new products, new packaging methods, new weighing and measuring devices and new demands for laboratory services are just a few of the areas in which we must develop a perspective of what tomorrow's demands may be. While many segments of industry are spending millions in research for new products, better methods or new devices, governmental agencies are not blessed with funds to make exhaustive surveys or investigations into the developments in these area. As a result, governmental agencies are consistently lagging behind or failing entirely to meet their responsibility, either to the industries to provide guidelines or to the public to provide protection.

The State of Washington is not unique as a jurisdiction whose tax dollars never seem to reach far enough to provide the service or protection her many agencies feel we should provide. A growing population such as we have in our State puts a constant strain on manpower available in our agencies to meet the demands. It is most improbable that we will receive enough tax dollars to provide an inspector for each 50,000 population. We also note that with the added emphasis on prepackage checking and the advent of multiple shopping centers this figure has now been revised and it is suggested an inspector for each 30,000 population. An even more impossible goal for us to achieve. The obvious answer is more detailed planning to better use the available manpower to meet tomorrow's situation. While this may seem to be afield from effective law enforcement, it is very definitely a part of the picture. To be effective, one must budget dollars for the neces-

sary equipment and provide careful program planning to utilize the manpower you are able to hire.

For budgetary purposes, we keep an accurate record of manhours devoted to (1) different classifications of equipment inspected and (2) prepackage inspection on a basis of lots and travel time. On a basis of actual count or conservative estimates, we are able to evaluate what kind of a job we are doing to meet our responsibility. I will not burden you with details, but just repeat: It is evident that under the present system and population growth, we can never meet the manpower requirement. I don't believe this problem is limited to the State of Washington. I read recently that by 1985 it is anticipated our national population will increase from the current 196 million to 266 million. Based on one inspector for each 30,000 population this would mean an increase of over 2,300 inspectors in the U.S. or about a seventy percent increase in weights and measures personnel. Where can we find tax dollars to provide such an increase? We shall return to the solution of this problem a little later.

At this point I would like to return to the Model Law and emphasize some of the effective tools available under its provision and especially in the field of prepackaging. In most instances of short weight or measure a simple "off-sale" action is all that is necessary to secure compliance by reweighing or remeasuring a particular lot of merchandise. On occasion, one finds a merchant that is somewhat reluctant to cooperate with the inspector. We have found the "stop-order" provision very effective. We had our stop-order forms printed on letter size sheets with the words "STOP ORDER" in bright red ¾ inch letters. We have not had an incident to date where a stop-order taped to a display of merchandise did not bring immediate compliance.

In many instances of "off-sale" action we found that frequently the store manager was not immediately available to receive a copy of the "off-sale" report. So the meat manager, the butcher, or other subordinate, who had a personal interest in the matter, made sure the store manager was not aware of our findings. As a result our reports were often filed in the waste basket. We plugged this loophole by sending out a follow-up form letter in each "off-sale" incident either to the store manager, home office of the chain, or to the responsible packer setting forth the location, date, items and reason for our actions. The effectiveness of this follow-up is exemplified by the number of phone calls we receive from all over the United States from packers requesting additional information on a particular lot of their product which we have moved against. I might also add that while these letters do not provide a basis for prosecution they are quite effective when placed in front of the prosecuting attorney as an indication of previous offences and to show that the offender has been reminded of what we had found.

As most of you know, the Model Law provides that we can only prohibit the sale of short weight or short measure merchandise. Whether the merchant repacks, if possible, or returns the lot to the packer is up to him. We sometimes suspected short weight lots only found their way to other outlets or other States. One of our inspectors had an occasion to overhear one end of a telephone conversation regarding a lot of short weight bacon he had just ordered off sale. The butcher readily admitted the wholesale representative had instructed him to simply hold the lot of bacon until the inspector had gone then put it back on the shelf. The wholesaler had assured the butcher that they would protect him by issuing a credit memo for the shortage in case the inspector made a follow-up on the disposition of the lot. This incident prompted us to take steps to control the off-sale items. We procured a steel die set of ⅛ inch letters as well as ⅛ inch rubber alphabet letters. These were mounted in wooden stamp handles. Each inspector was assigned a different letter. Impressions are made at the lower right-hand end of the brand name, on the principal panel, either with the steel die or firm cardboard cartons, or with the rubber letter and non-toxic, quick-drying ink on soft or frozen items. Each of the local jurisdictions and the Pacific coast States were alerted to our system. Each off-sale package is marked and the prepackage report indicates the number of individual packages stamped with the inspector's identifying letter. The letters are big enough for identification but still do not mutilate the package if the packer desires to repack utilizing the original container. Our inspectors are advised that any lots found bearing any other inspector's letter are to be rechecked in case it had been repacked and brought into compliance. I must be frank and admit that although we had one prior case which resulted in a $75.00 bond forfeiture involving re-submitting off-sale items that had not been corrected, we have not found an opportunity to take action under this system. We are, however, reasonably sure that it is an invaluable deterrent to those who might otherwise try to avoid costly repacking.

Some two years ago we provided our inspectors with a form to report incidents of mislabeling. In all cases where a quantity statement failed to appear, off-sale action was taken. If it involves a technical infraction such as qualifying terms or failure to express the quantity statement in the largest applicable unit, the report form was made out and the necessary correspondence and follow-up was carried on from the Olympia office. To keep the local city jurisdictions and our State inspectors abreast of developments, each infraction was given a number and, after a sizable list was developed, a master sheet was mailed to each. Thereafter, supplements were supplied showing new contacts or those that had complied either with corrections or a given date when we could expect new labels to appear on the shelves. In keeping with guidelines set up at our Western Weights and Measures Conference in Boise in 1962, reasonable periods of time were allowed for corrections

of plates and dies and utilization of existing supplies of labels. In this area we are pleased to report the effort expended by our office, several other States, and the common desire of all industries to abide with legal requirements has resulted in a very gratifying program. The cooperation of manufacturers, packers, printers, labelers and carton manufacturers has been very pleasing. With new companies and new products requiring education and follow-up it seems to be a never ending job. We must give credit to the fine effort made on the part of many of the nationwide industry associations to apprise their members of labeling requirements. I feel this, more than any other single effort, has brought about improved labeling.

I would like to mention one other form which we developed lately that might be of benefit to you in your prepackage work. No doubt many of you have adopted the standard prepackage report form (suggested by the Office of Weights and Measures) or a facsimile thereof. We found that completing a form for each approved lot checkweighed or measured was time consuming and used lots of paper and postage. We have now developed a single sheet designed to list the pertinent information on ten different lots. The information includes the name and address of the store, name and address of the manufacturer, packer or distributor, lot numbers or code, number sampled, number in the lot, and size of the individual units. It has been estimated the use of this form will save us some $200 a year in postage and increase the number of lots checked by at least twenty-five percent. We still make out the regular perpackage form on any lots ordered off sale and process them in the normal manner.

I have not recited the foregoing activities with any intention of bragging but rather for the single purpose to emphasize some of the tools available under the Model Law and Regulation.

As we look for solutions to our problems, we realize that planning is a continuous process. This involves establishing goals and formulating plans of action which will allocate available resources in the most effective and economical manner possible to achieve our goals. Our task is complicated by such factors as economic change, unusual growth in population, and the resulting increase in responsibilities.

Where do we go from here? How do we meet the problem of the limited tax dollar? Where do we find a solution to an inadequate number of inspectors?

We have been embarrassed frequently when reminded by a device owner that the date on the approval seal indicates that an inspector had not called on him for two and sometimes three years. What I'm saying is that with our growing responsibility we find it impossible to comply with the mandatory annual inspection of commercial weighing and measuring devices. We are also concerned that on many occasions we are faced with an irate owner, when we find the error in

his device is costing him money, blaming us because we had not made an inspection earlier to advise him of the error. It is doubtful that this attitude is limited to our jurisdiction. Such incidents emphasize that we have lost sight of the original purpose of mechanical inspection. I believe I am correct in assuming it was for the purpose of determining that the owner was maintaining the accuracy of his device. There is no doubt many contributing factors to the decline of this ideal. An over-emphasized sense of service to the taxpayer, patronage, and a desire for good public relations are some we might mention. In the interest of meeting our responsibility to all our constituents we have attempted to evaluate how we might more effectively use our manpower. This involved considering available tax dollars to provide men and equipment to meet the intent of a weights and measures program. It was evident that we had the necessary tools. These consisted of a good law, reasonably modern regulations, an effective educational program, a basis for prosecution when necessary, modern test equipment, and well-trained personnel throughout the State and local jurisdictions. What is our next step? Where do we go from here? We believe improvement lies in the area of mechanical inspection.

We have been watching with interest the "Selective Testing" program in the State of Wisconsin. We believe it has a lot of merit, particularly in placing the responsibility for accuracy where it belongs: with the device owner. We further feel that utilizing such a program is the only way we will ever be able to adequately deploy our personnel and equipment. We are currently taking steps to amend our law to delete the requirement for annual testing and approval. We sincerely hope that the 1967 Legislature will recognize our need in this area and modify our statute to permit selective testing. The budgetary scramble for the tax dollar is a common sports event in nearly all jurisdictions. We have it and I'm sure everyone of you who have budget responsibilities join in the competition every financial period. It seems the budget committee becomes impervious to the adjectives one uses to describe the needs. One cannot give up but must continue in the conflict to obtain the dollars available for men and equipment. Continued population growth and added responsibility demands an expanding program based upon projected needs. History and experience dictate that we cannot hope for budget dollars to grow as rapidly as a booming economy. This results in an obligation to carefully analyze the best possible method to expend the funds allotted for your program. Intelligent use of the tools of enforcement available to us, coupled with long range planning and proper deployment of manpower is what we intend to use in the State of Washington to produce the best possible program.

LEGAL CONSIDERATIONS OF THE MODEL STATE LAW ON WEIGHTS AND MEASURES

by G. A. Christenson, *Assistant General Counsel for Science and Technology, U.S. Department of Commerce*

It is a pleasure to appear before this Fifty-first National Conference on Weights and Measures. The first Model State Law on Weights and Measures, adopted forty-five years ago by the Sixth National Conference on Weights and Measures, has been the subject of continued study over the years. Succeeding conferences have revised the Model Law as seemed desirable.

Individual States have used the Model Law as a basis upon which individual State laws could be enacted. I understand that the legislatures of 21 States have enacted the Model Law in substantially its present form. The laws of the remaining States differ from the Model Law, some in a few respects, and some in many. Thus, the States have many varying versions of law on weights and measures. I cannot discuss all of these different statutes in the time available, but must confine myself to the present version of the Model Law.

In recommending improvements to State weights and measures laws, and in administering those laws, the State members of this Conference must find a reasonable balance between conflicting interests. On the one hand, there is your duty to protect the citizens of your States against inaccurate use or false marking of weights and measures. On the other hand, we find a national need to promote the flow of commerce through uniform national weights and measures to minimize the burdens on the exchange of goods and services across State boundaries. Also, there is the goal of avoiding unreasonable discrimination against those who actually exchange goods and services—the producer, the distributor, the user or consumer. Our society believes it is good to have the widest sharing and distribution of these goods and services. Fully aware of the dangers of oversimplistic solutions, I shall attempt to clarify some problems which can arise in administering the Model State Law on Weights and Measures and make suggestions when appropriate.

Any review of the Model Law must begin with an understanding of the relationship between Federal and State regulation of commerce generally, and weights and measures in particular. This paper will consider, first, the legal aspects of this problem. The next problem I will discuss is what constitutional limitations there are on the power of the States to regulate interstate commerce. Generally, these lim-

itations include the "burden on interstate commerce" doctrine and the due process provision of the Fourteenth Amendment. Third and last, this paper will examine constitutional limitations upon State exercise of police power, and I will touch on the search and seizure problem under recent Supreme Court decisions.

Federal-State Regulation of Weights and Measures: Preemption.

There are several express powers in the Constitution which authorize the Congress to regulate weights and measures nationally through preemption. The most pertinent, but least used, provision occurs in Article I, Section 8, Clause 5, which gives the Congress the power to "fix the standards of weights and measures." Congress has only exercised this power in part, and not to the extent of preempting the States from regulating weights and most measures. In the 1830's, Congress authorized the distribution of standard weights and measures to the States, and they have been uniformly adopted as the basis for State regulation of weights and measures. In 1866, Congress authorized use of the Metric System of weights and measures in the United States. The Act of 1866 [1] makes legal the use of metric units and thereby limits the States from prohibiting the expression of weights or measures in those units. Of course, the States still may require sellers to include customary units in addition to metric units. A measure now before Congress would authorize the Secretary of Commerce to conduct a study to determine whether and to what extent the Nation should convert to the use of the Metric System. Congress has established national units of electrical and photometric measurement for the United States.[2]

Congress also has the authority to regulate interstate commerce, and has used this authority more generously in weights and measures matters closely connected with products affecting health or safety. Fortunately, the mere existence in the Congress of the power over interstate commerce, or the partial exercise thereof, has not excluded or prevented the States from imposing certain types of regulation upon interstate commerce, in the absence of Federal regulation totally occupying the field. This issue was settled in 1851 in the case of *Cooley* v. *Board of Wardens of the Port of Philadelphia*, 12 Howard 299, decided in 1851.[3] State power over interstate commerce has been limited, however, by subsequent decisions protecting interstate commerce against undue burden or discrimination, as I will discuss later. Otherwise, the States still have the power to regulate commerce to the extent that Congress has not preempted the field in the process of regulating interstate commerce.

[1] Act of July 28, 1866, 14 Stat. 339, R. S. Sections 3569, 3570 (15 U.S.C. 204, 205).

[2] Act of July 21, 1950, as amended (15 U.S.C. 223, 224).

[3] For earlier cases leading to this decision, see *Sturges* v. *Crowninshield,* 4 Wheaton (17 U.S.) 122, 192–197 (1819), *Houston* v. *Moore,* 5 Wheaton (18 U.S.) 1 (1820), *Willson* v. *Black-bird Creek Marsh Co.,* 2 Pet. (27 U.S.) 245, 251, 252 (1829).

The principal exercise by Congress of the interstate commerce power in a manner affecting State regulation of weights and measures, is what is now called the Federal Food, Drug, and Cosmetic Act. Section 403 of the Act (Section 343 of Title 21 of the United States Code) states that a food shall be deemed to be misbranded if its labeling is false or misleading in any particular, if its container is so made, formed, or filled as to misleading or, if it is in package form, unless it bears a label containing the name and place of business of the manufacturer, packer, or distributor and an accurate statement of the quantity of the contents in terms of weight, measure, or numerical count with certain minor exceptions. There are other Federal acts containing weights and measures provisions such the Meat Inspection Act and the Poultry Products Inspection Act. The question is to what extent do they preempt State action.

An early case, construing the effect of similar provisions in the Food and Drug Act of 1906, held that they did not fully preempt the field. In *Savage* v. *Jones*, 225 U. S. 501, decided in 1912, a statute of the State of Indiana required that a certain proprietary food have on its label a list of ingredients and minimum percentages of crude fat and crude protein and the maximum percentage of crude fiber. A proviso in the Federal Food and Drugs Act stated that the Act was not to be construed as requiring manufacturers of proprietary foods, containing no unwholesome added ingredients, to disclose their trade formula, with certain exceptions not material here. The Supreme Court construed the Federal Act as not limiting State power to require additional information on containers of the product sold within the State. The Court stated that congressional intent to restrict the exercise by the State of this police power is not to be implied unless the act of Congress fairly interpreted is in actual conflict with the law of the State.

Later cases cast further light on the relationship between Federal and State laws on labeling of packages. They show that a State may not require the substitution of a State-approved label for a Federally approved label.[4] However, the State may reasonably require additional material to be placed upon a label so long as it does not require the removal of Federally-approved information from the label.[5] As further examples, the States may regulate production of commodities within their boundaries even though some of the commodities will flow into interstate commerce, so long as they do not act in a manner inconsistent with acts of Congress.[6] State regulation may reach the packaging of foods in certain standard quantities.[7]

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[4] *McDermott* v. *Wisconsin*, 228 U.S. 115 (1913).

[5] *Corn Products Refining Co.* v. *Eddy*, 249 U.S. 427 (1919).

[6] *Sligh* v. *Kirkwood*, 237 U.S. 52 (1915).

[7] *Armour & Co.* v. *North Dakota*, 240 U.S. 510 (1916). Opinions by Justice Holmes on State power to regulate retail sale of food are found in *Weigle* v. *Curtice Brothers Co.*, 248 U.S. 285 (1919) and *Hebe Co.* v. *Shaw*, 248 U.S. 294 (1919).

The modern case-law which we have found on preemption appears to fall into three general categories:

1. Areas of law inherently requiring national uniformity.
2. Areas of law where Congress has either expressly indicated its intent on preemption of State law, or has expressly indicated a strong Federal interest in achieving national uniformity.
3. Areas where the intent of Congress is not clear.

Federal preemption clearly occurs in areas of law inherently requiring national uniformity. A leading example of this doctrine is the Federal alien registration system, which requires clear national standards. The Supreme Court has distinguished this type of preemption from cases involving State laws regulating the labels on containers of food.[8] Though it may be desirable, national uniformity for food labels is not an inherent necessity. A congressional intent, therefore, must be found before preemption occurs.

In *Rice* v. *Santa Fe Elevator Corporation*, 331 U.S. 218, decided in 1947, the Supreme Court found an express indication of intent to preempt in the legislative history of a 1931 amendment to the U.S. Warehouse Act. In that case, the Court ruled that if the matter on which the State asserted the right to act was in a way regulated by the Federal act, the Federal scheme prevailed even though it was more moderate and less pervasive as a regulatory plan than that of the State. On the other hand, if the Federal act made no attempt to regulate in certain areas, then State law still applied. In a more recent case, legislative history showed a strong intent to provide a uniform system throughout the United States for the grading of tobacco under the Federal Tobacco Inspection Act. Therefore, the Act was held to preempt the field as against a State law requiring additional information to appear on graded tobacco sold within the State.[9]

In a case decided this January, the Supreme Court found evidence of a congressional design not to preempt a field from State regulation.[10] Over a vigorous dissent, the Court carefully reviewed the legislative history of Public Law 88–108, authorizing arbitration of certain railroad labor disputes, and held that the Act and arbitration award made under it were not intended by Congress to preempt the full crew laws of any State. The dissent by Justice Douglas stressed the national character of the problems of automation and technological change. He argued that these require national treatment which was inherent in the arbitration law.

The troublesome case is one where someone must act, but neither State nor Federal officials know whether Congress intended Federal preemption. The Supreme Court has decided some of these cases in recent times, where congressional intent was not clear. For instance,

[8] *Hines* v. *Davidowitz*, 312 U.S. 52, 68 (1941).
[9] *Campbell* v. *Hussey*, 368 U.S. 297 (1961).
[10] *Engineers* v. *Chicago, R.I. & P.R. Co.*, 382 U.S. 423 (1966).

the Court held that the City of Detroit could impose smoke emission standards upon vessels subject to Federal inspection and licensed for operation in interstate commerce.[11] The Federal inspection was not for compliance with emission standards, but rather for compliance with standards of vessel and boiler safety. The city smoke abatement ordinance was clearly within the lawful exercise of State police power to protect local health.

The significant case of *Florida Avocado Growers* v. *Paul*, 373 U.S. 132, decided in 1962, held a Federal standard for avocado harvesting did not preempt a different California standard on the same subject matter. The Federal standard was established under the Federal Agricultural Marketing Agreement Act of 1937. The standard established dates for picking avocados which were recommended each year by a local committee in Florida, and approved each year by the Secretary of Agriculture. The California agricultural code used a different standard which prohibited the sale within the State of California of avocados containing less than eight percent of oil by weight. In recent years, approximately six percent of the Florida avocados shipped to California had been rejected as not meeting the California eight percent oil content test. The question was whether the Federal standard for the harvesting of Florida avocados preempted the California standard, preventing its application to Florida avocados sold at retail in California. The opinion of the five-member majority of the Court considered many factors in reaching its conclusion, including the histories of the two statutes, the method by which the Federal standard was determined, and the interest of the State of California in preventing the marketing to its citizens of unwholesome food. The Court held that the intent of Congress in the Federal act was to provide a mechanism for regulating the processing of food prior to its marketing to the public. Therefore, the Federal standard did not preempt the California State standard. It should be noted, however, that the case was sent back to the District Court for further findings. It was not clear from the record whether the California standard discriminated against Florida fruit, because of differences between the different varieties grown in the two States. If the California oil test was too strict a test for the variety of avocado grown in Florida, it would be held to be an unconstitutional burden on interstate commerce, as I shall cover later.

In a third recent case,[12] a newspaper and a radio station were located in New Mexico near the border with Texas. A New Mexico court ordered the newspaper and radio station to stop publishing and broadcasting advertising of a nearby Texas optometrist in violation of a New Mexico statute governing the practice of optometry. The

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[11] *Huron Cement Co.* v. *Detroit*, 362 U.S. 440 (1960).
[12] *Head* v. *New Mexico Board*, 374 U.S. 424 (1963).

Supreme Court was asked to reverse as to the radio station on the ground that preemption by the Federal Communication Act prevented the State from imposing any form of regulation on radio stations. The Court stated that the Congress had given the Federal Communications Commission no specific mandate in this area and that there was no showing of actual conflict between regulation under the Federal Communications Act and the State law prohibiting advertising by optometrists within the State. On the other hand, the State statute was found to be a measure directly addressed to the protection of the public health and clearly within the area closely identified with State interest. The Court stated that since this was not in an area of law inherently requiring national uniformity, there must exist such actual conflict between the two schemes of regulation that both cannot stand in the same area, or else there must be evidence of a congressional design to preempt the field, before the State statute can be held unenforceable against radio stations. The Court found evidence of neither in this case and affirmed the judgment of injunction.

The above cases indicate that where Congress has not expressly indicated its intent, the courts will recognize legitimate State interests in the protection of State citizens, if the State's law is not in actual conflict with Federal law or its basic purposes. These conclusions apply to current laws, such as the Federal Food, Drug, and Cosmetic Act, and similar laws providing weights and measures authority within the general area of product inspection.

The Congress is now considering a Fair Packaging and Labeling Act which, in its present form, would expressly preempt conflicting State law in an area that is now largely subject to State control, on the grounds that national uniformity in sizes labeling, weights, and quantities of consumer commodities is desirable not only as a basis for exchanging products nationally, but also to provide increased status to the consumer from a national point of view. If advertising is nationwide, so also consumer interests should be expressed nationally.

The Doctrine of Undue Burden on Interstate Commerce.

Even where Congress has not preempted the field, the Federal courts may strike down any State regulation that is so arbitrary in its operation as to violate the due process clause of the Fourteenth Amendment to the Constitution and any State regulation over interstate commerce that constitutes an undue burden on interstate commerce or that discriminates unduly against out-of-State manufacturers and shippers.

These doctrines are basic constitutional concepts in the area of standards and laws regulating the exchange of goods and services. As we explore these judicial doctrines, we will note a shift in emphasis of the case-law from giving reference to the right to contract to support-

ing the right of State and Federal Governments to establish law that is concerned with the functional status of particular goods and services. Formerly the courts recognized rights to contract with respect to any goods or services, with less emphasis on the overriding public interest. That means we now look to weights and measures laws or product standards as the common ground on which goods are exchanged. No longer in a complex product line is freedom of contract—*caveat emptor*—sufficient to continue its leavening and freeing effect. The freedom to contract opened the new law merchant and produced the commerce that helped stabilize and restructure modern Europe and the West. Economic freedom was important to the merchants and guilds. For the serf who was tied literally to the land, this new-found freedom gave him and others independence.

Now the consumer needs standards to choose by. Even more, he should participate in the process by which those standards for aiding choice are issued, for in the market place he buys according to the established standards. Sensible weights and measures regulations always try to bring producer and user together at a common meeting ground.

The doctrine of undue burden on interstate commerce seems to be moving toward national standards for exchanging goods and services, for it intervenes where there are burdensome or conflicting State requirements. Since the consumer now is receiving national status as a participant in commerce, the undue burden doctrine could well be used to reflect this status. This Conference has always been concerned with the relationship between the purported quantity of goods, in a sale thereof, and the actual quantity. It has always sought to provide uniform protection for the consumer in these sales. So the movement toward national weights and measures and national product standards is a continuation and expansion of efforts of the sort that your Conference has engaged in for more than half a century. Let me be emphatic here. I am not referring to national in the sense of Federal, but rather in the sense of national uniformity to reduce burdens on Commerce. As we see, when the burdens become too great, the Federal courts step in to protect the country's interest in reducing barriers to a genuinely national system of exchanging goods and services.

Consider two cases illustrating a change in thought toward efforts of the States to set minimum standards for goods and services with the consumer in mind. In 1924, the Supreme Court held invalid a Nebraska statute which set maximum and minimum tolerances over a period of 24 hours for the weights of both wrapped and unwrapped loaves of bread. The Court held that the statute violated the due process provisions of the Fourteenth Amendment.[13] There was

[13] *Jay Burns Baking Co.* v. *Bryan*, 264 U.S. 504 (1924).

evidence, particularly as to unwrapped loaves, that loaves baked to meet the maximum weight tolerance would fall below the minimum weight tolerance before the end of 24 hours by reason of ordinary shrinkage on dry days. There was also contrary evidence relied upon by the State legislature and the State courts in approving the statute. Furthermore, the 14th National Conference on Weights and Measures had considered and endorsed legislation similar to the Nebraska statute. Justices Brandeis and Holmes disagreed with the Court. They dissented on the ground that in dismissing the evidence accepted by the State legislature and the State courts and relying upon the contrary evidence, in effect, the court was acting as a superlegislature. Section 33 of the Model State Law on Weights and Measures reflects a reasonable balance between the majority and minority of the Court. The tolerances are not fixed by statute, but by regulation, so that while tolerances are necessary, they may vary.

So, in 1924, the Supreme Court held unconstitutional an attempt by Nebraska to impose certain standards upon bread. The obligation of contract was still being given preferred treatment as against the interest of the States or Nation in protecting citizens against deceptive practices in consumer items. However, the Court takes a different view today, and has even commented upon the 1924 case, in a recent case. The opinion by Justice Black stated that the doctrine of the 1924 case, and like cases, ". . . that due process authorizes courts to hold laws unconstitutional when they believe the legislature has acted unwisely—has long since been discarded." [14]

The courts now generally leave considerations of economic due process to the legislatures. In this respect the Supreme Court has been passive. However, it has been active in other areas of law—as you know in civil rights and reapportionment, where Constitutional limitations on the powers of the States are being given effect. Considering the Constitutional limitations on the States not to place undue burdens on interstate commerce, the Court could very well become active in encouraging national standards for goods and services to protect the consumer and national producers and distributors. A possible extension of the undue burden doctrine could limit the States' power to impose weights and measures laws which interfere with the national and perhaps even international flow of commerce from producer to distributor to consumer.

Only four months ago, a three-judge district court considered a State law requiring special labeling of meats and meat products of foreign origin and a special license to sell them. The Court held the law unconstitutional for imposing an undue burden on interstate and foreign commerce.[15] This doctrine, which is pertinent to modern

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[14] *Ferguson* v. *Skrupa*, 372 U.S. 726, 730 (1963).
[15] *Tupman Thurlow Co.* v. *Moss*, 252 F.S. 641 (1965).

problems arising out of the movement of goods and services in interstate and foreign commerce, arose in the 19th century out of the efforts of States to regulate portions of interstate railroads.[16] Some forms of regulation have been permitted, but others have been overturned by the Supreme Court on the ground that they burdened, interfered with, or discriminated against, interstate commerce. Recent Supreme Court cases continue to apply this doctrine.

Before considering the degree of burden on commerce, the courts will look to see if Congress has acted through positive legislation to preempt the field. In the leading case of *Southern Pacific Co.* v. *Arizona*, 325 U.S. 761, decided in 1945, Justice Stone's opinion carefully reviewed an Arizona law limiting the length of all trains in the State to 70 cars for freight trains and 14 cars for passenger trains. First he showed that the law was not in an area of law preempted by any Federal statute. He then examined the facts showing that, even though the measure was enacted as a safety measure the railroads in Arizona had no better safety records than railroads in neighboring States without such train limit laws. He then showed that interstate commerce through Arizona was being materially delayed because longer trains had to be broken in two at one Arizona border, and reassembled at the other. Furthermore, the State Law was shown to decrease railroad operating efficiency and economy.

The Court, after balancing the interests of the State in enacting a safety measure shown to have at most slight and dubious advantage, and the interests of the nation in having efficient interstate commerce, concluded that the train length law was an undue burden on interstate commerce. Justice Black dissented on the ground that this case was another example of the Court's acting as a superlegislature, but it is quite clear from the majority opinion that the holding was not based on the due process clause. Four years later, the Supreme Court also overturned a New York statute regulating the purchase and shipping of milk in interstate commerce, over similar objections by Justices Black and Murphy and additional dissents by Justice Frankfurter and Rutledge.[17]

Interestingly enough, there was no dissent in the 1959 case of *Bibb* v. *Navajo Freight Lines*, 359 U.S. 520. That case held an Illinois statute requiring a contour mudguard on all trucks using the State's highways to be undue burden on interstate commerce. There was conflicting evidence as to whether the mudguard was more efficient than ordinary mudguards. Trailers used by motor carriers in other States could not be used in Illinois, and it appeared that the mudguard required in Illinois was illegal in at least one other State. The Court balanced the State interests against the interests of interstate commerce and decided that the heavy burden placed upon interstate commerce by the

[16] The doctrine was stated in 1886 in *Wabash, St. L. & P.R. Co.* v. *Illinois*, 118 U.S. 557.
[17] *Hood & Sons* v. *Du Mond*, 336 U.S. 525 (1949).

local measure outweighed the rather inconclusive showing of safety benefit to Illinois residents.

In the 1963 *Florida Avocado Growers* case, which I outlined for you earlier, the Court returned the case to the lower courts to determine whether the California statute on avocados unduly discriminated against the varieties of avocados grown in Florida. All these recent cases suggest that it is not so simple a proposition to say that if the Congress has not acted in the field the residual police power to protect citizens rests with the States. The Supreme Court decisions seem to be based increasingly on an analysis of all factors relevant and an assessment of whether the State law unduly interferes with a national flow of commerce which may now include a national standing for the consumer in the flow of commerce.

Now consider the case of flour shrinkage in interstate commerce. Assume that two flour mills market flour in a particular State, and that one mill is within the State, while the other is located outside the State some distance away. Under the Model State Law on Weights and Measures and the interpretation recommended by the 44th National Conference on Weights and Measures [18] the miller within the State may pack his bags of flour for sale in the State at almost exactly the net weight stated on the bag, with a very small allowance for the shrinkage that will occur between its being packed and its first sale. However, the miller located outside the State must overpack, according to my understanding, by as much as two percent and in some cases four or perhaps five percent to allow for the shrinkage which may normally and unavoidably occur between packing outside the State and the first delivery within the State.[19] As the Model Law is now written and interpreted, the bag of flour shipped into the State must still meet or exceed its stated net weight at the time of its entrance into the State despite the unavoidable loss of moisture.

This statement of facts shows that as between the two producers there is a clear preference in favor of the local producer under the present Model Law. Is there an undue burden on interstate commerce, however? The interests of the States and of consumers must be considered before attempting to determine whether the discrimination is reasonable or is unconstitutional.

There is a long history of regulation of weights and measures by the community, dating back to ancient civilization. This long history is based upon practical needs, such as the needs of buyers to know how much they are buying so they may make meaningful comparisons and the needs of sellers to ensure that they may compete upon an equitable and fair basis. Also important is the fact that in our national com-

[18] Conference proceedings, p. 26 (1959).

[19] See Anker, Geddes & Bailey, A Study of the Net Weight Changes and Moisture Content of Wheat Flour at Various Relative Humidities, 19 Cereal Chemistry 128, 147 (January 1942).

merce, goods produced in one part of the country can be expected to be sold in many parts. Consequently, the State and the community both have a very strong interest in protecting consumers and honest businessmen against misstatements of weight or measure and to assure the freest possible flow of commerce.

It can be argued that Federal statutes, such as section 403 of the Food, Drug and Cosmetic Act, requiring statements of net weight on foods shipped in interstate commerce offer sufficient protection of the interests of the consumers in one State insofar as foods from other States are concerned. However, we understand that the States may have or may obtain evidence showing that additional State weights and measures inspections are required if the wellbeing of citizens of the State is to be protected.

It can be argued that to reduce the burden on out of State flour millers a State should make moisture measurements of flour shipped into the State to determine whether the bag of flour met or exceeded its stated net weight at the time it was packed. However, we understand that it is not easy or inexpensive to measure the moisture of flour and that existing testing methods are not as precise as we might desire. So if the State inspects for actual net weight at the point of entry into intrastate commerce, is the advantage to the local seller an undue burden on commerce? In other words, is it reasonably related to protecting the legitimate consumer interests from a national point of view? In 1891, for example, a Virginia statute which required the inspection and labeling of all flour brought into the State for sale was held invalid because flour produced in the State was not subject to inspection.[20] A Madison, Wisconsin ordinance, which excluded a foreign corporation from selling milk in the city solely because its pasteurization plants were more than five miles away met a similar fate.[21]

Depending on the facts, the Supreme Court in a case today could well hold that the interests of national consumers and producers in the flow of commerce in flour and other shrinkage items should be protected against the discrimination that may result under the present Model Law. There are many Supreme Court cases holding that no regulation of interstate commerce is preferable to forms of State regulation that burden interstate Commerce.[22] In some instances, Congress has followed up these cases by imposing Federal regulation, filling the void left by Court decision.

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[20] *Voight* v. *Wright,* 141 U.S. 62 (1891).

[21] *Dean Milk Co.* v. *Madison,* 340 U.S. 349 (1951).

[22] See, for example, *Wabash, St. L. & P.R. Co.* v. *Illinois,* supra, denying States the power to regulate rates and practices of interstate commerce by rail; *Pub. Util. Comm.* v. *Attleboro Co.,* 273 U.S. 83 (1927) denying State Public Utility Commission the power to regulate rates for interstate sales of electricity; *Missouri* v. *Kansas Gas Co.* 265 U.S. 298 (1924) denying State the power to regulate rates for interstate sales of natural gas.

In the case of flour shrinkage, such a decision would not even leave a void in the law because Federal law does already require accurate statements of net weight on food packages shipped in interstate commerce. The Court might hold that the States can keep interstate packers from mulcting the public by establishing broader tolerances for foods shipped into the State, accounting for the shrinkage that reasonably may occur. On balance, I feel that there is a sufficient likelihood that the present law could be held to be an unconstitutional burden on interstate commerce to merit suggesting to the Conference that it explore alternatives in protecting consumers from a national point of view (though not necessarily Federal) where producers could also have national uniform treatment. I also make this suggestion because I know that this Conference earnestly seeks to ensure "that equity may prevail," and the present distinction between in-State, and out-of-State food packagers of shrinkage products and their sales to consumers all over the country may be inequitable from the point of view of a national flow of commerce.

Specifically, a forward looking model law should reflect the national interests of producers, distributors and consumers alike. A suggestion I recommend for your consideration is that the Model Law be amended by the insertion of a section instituting reciprocity among the States in the area of weights and measures regulation and inspection of the net weighing of products. In addition to possible changes in sections 26 and 29, the new section would provide that a State would give reciprocal treatment and respect to the weight of prepackaged commodities received from a State that inspects all of the prepackaged shrinkage items produced in the State according to certain uniform minimum standards recommended by this Conference. Thus, States receiving goods shipped in interstate commerce would be giving full faith and credit to the inspections performed by officials of the States in which goods originate, under uniform national standards, to protect all consumers against short weighing by packers and at the same time to reduce burdens on commerce. Present section 26 would have to extend States discretion to setting tolerances based upon the reciprocal arrangement rather than from the point at which a product enters intrastate commerce.

I realize that working out specific language to accomplish this purpose may take a little work. Some of the issues involved are rather delicate. Nevertheless, I recommend this Conference take leadership in setting national standards for exchanging goods on the basis of uniform weights and measures which treat national producers and national consumers alike. If this approach can be successfully implemented, it will be inherently fairer to packers of shrinkage items as well as other items, and it will enable the States to protect their citizens at the same time as protecting all citizens against short weighing at

the time of packing. It could promote genuine national uniformity in weights and measures without the need for Federal legislation. Ultimately, the Conference may have to redefine "intrastate commerce," which as it is presently defined in the Model Law rests on the traffic theory of commerce, whereas, a national theory of commerce as applied by the Supreme Court would reject as artificial any line drawn as when a sale or delivery to a common carrier for sale takes place.[23]

The proposed Fair Packaging and Labeling Act could also affect present State law on net weight statements on shrinkage consumer commodities. The Act, as presently written and as passed the Senate, would exclude three shrinkage commodities meat, poultry and tobacco, but not flour. If the Department of Health, Education, and Welfare or the Federal Trade Commission determine that the required net quantity statement shall accurately reflect net quantity at the time of entrance into interstate commerce, it could very well be held that the States could not enforce any differing standard, such as net weight at the time of entering intrastate commerce (which is provided in the Model State Law on Weights and Measures) upon commodities moving between the States.

Enforcement: Searches and Seizures.

Let us now turn to the enforcement provisions of the Model Law. The Model Law in section 16 empowers the director of weights and measures with special police powers. He may arrest without formal warrant any violator. He may "seize for use as evidence" without formal warrant any incorrect or unsealed weights or measures of packages of commodities sold or for sale in violation of law. He is authorized to enter "any structures or premises" without warrant and to stop any person and require him to go to a specific place.

I should first comment on the case of *Mapp* v. *Ohio*, 367 U.S. 643, decided in 1961, in which the Supreme Court held the search and seizure provision of the fourth amendment of the Constitution applicable to the States through the due process clause of the fourteenth amendment. The fourth amendment protects against "unreasonable searches and seizures." This means there is a similar constitutional requirement imposed on States. In most situations, State police officers are required to obtain a search warrant based upon probable cause

[23] The concept that commerce was traffic—that it began with an act of transportation from one State to another—resulted in a false deduction that the only commerce Congress may regulate is an act of transportation to the point of being wholly an intrastate matter. Such an artificial definition of commerce was perpetuated in the 1918 case of *Hammer* v. *Dagenhart*, 247 U.S. 251 (1918), which held that an act forbidding manufacturers and others to offer child-made goods for transportation in interstate commerce was void as violating the reserved powers of the States. This holding and rationale was overruled formally in 1941 by the case of *United States* v. *Darby*, 312 U.S. 100 (1941). The Model State Law on Weights and Measures has not adequately reflected the 1941 decision which in effect rejected artificial distinctions between national and State flow of commerce.

and describing the place to be searched and the evidence to be seized before performing search and seizure, if the evidence is to be admissible. This type of control is spelled out in the fourth amendment. The principal exception to the rule allows search and seizure pursuant to a lawful arrest. Arrest without formal warrant is constitutionally permissible if, at the time of arrest, the officer had probable cause to believe that the person being arrested had committed, or was committing, an offense.[24] If an arrest is lawfully made, a reasonable search and seizure of evidence may also be conducted.[25]

The fourth amendment protections apply to corporations and to business premises, but in a reduced manner. There must be an inquiry or investigation authorized by law, and the search must be restricted to materials that are "adequate, but not excessive, for the purposes of the relevant inquiry." [26] Congress has exercised this authority in Section 704 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 374), by authorizing Federal agents to enter at reasonable times, places reasonably connected with preparation and storage of foods destined for interstate commerce, to inspect the goods and to take samples.[27]

The courts are much more restrictive of executive power to inspect private residences without warrant or probable cause to arrest. But there are a few exceptions.

For example, in *Frank* v. *Maryland*, 259 U.S. 360, decided in 1959, the Supreme Court has affirmed the authority of a Baltimore city health inspector to enter and inspect a private dwelling in the daytime without warrant when he suspected rat-infestment. Furthermore, the use of an administratively-granted warrant is held to authorize search and seizure in immigration and naturalization cases.[28]

The second sentence of Section 16 of the Model Law in rather sweeping terms authorizes the director to inspect, the only limitation being the phrase "In the performance of his official duties . . ." Section 17 authorizes the director to issue specific instructions to inspectors covering the actual exercise of inspection authority and other police power authorities.

I am in complete agreement that under Section 16 you can constitutionally enter and reasonably search or inspect any commercial establishment conducting activities subject to regulation under weights and measures law. But an officer who interpreted the phrase in Section 16 "the director is authorized to enter and go into or upon, without formal warrant, any structure or premises," to include private dwelling houses might conduct an unconstitutional search. The

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[24] *Beck* v. *Ohio*, 379 U.S. 89 (1964).
[25] *Harris* v. *U.S.*, 331 U.S. 145 (1947).
[26] *Oklahoma Press Pub. Co.* v. *Walling*, 327 U.S. 186, 209 (1946).
[27] See *Durovic* v. *Palmer*, 342 F. 2d 634 (C.A. -7, 1965) approving inspection under the statute.
[28] *Abel* v. *U.S.*, 362 U.S. 217 (1960).

Frank v. *Maryland* case was decided by a sharply divided court, with four Justices dissenting. I have my doubts as to whether the doctrine of that case would be extended from State protection of public health to State regulation of economic concerns, such as quantity declaration of goods.

Consequently, I recommend that this Conference consider limitations upon use of authority to arrest or search without a warrant to avoid conflict with citizens' constitutional rights. You could do this by recommending amendments to Section 16. Alternatively, since use of special police powers under the Model Law is subject to regulations issued by State directors and city and county sealers, in their respective jurisdictions, the Conference could recommend a set of uniform regulations on arrest, search and seizure, and the remaining issues that I am about to mention, to be issued by those officials. The latter approach appears to be more flexible and could be implemented more readily by State and local officials.

The intent of the Model Law with respect to weights, measures, and weighing and measuring devices needs clarifying in the light of *Plymouth Sedan* v. *Pennsylvania*, 380 U.S. 693 (1965). That case distinguished between articles, such as narcotics and unlicensed stills, which may not be lawfully possessed at all, and articles that become forfeitable because of their use in an unlawful manner, such as a motor vehicle that has been used to transport untaxed alcoholic beverages. An article that has merely been used unlawfully may only be condemned or forfeited if the evidence was obtained within the limits of the fourth amendment. If possession of an article is unlawful, it may be condemned or forfeited regardless of the manner in which the State obtained it. It is not clear whether the purpose of the Model Law is to place inaccurate weights, etc., which are incapable of repair, in the category of objects which may not lawfully be possessed. A clearer statement of that purpose might be desirable to help in administering the Model Law authority to condemn in Section 15.

Sections 13 and 14 of the Model Law give broad authority to order that packaged goods be put off sale and disposed of only in a manner approved of by the director. But the Model Law gives the director no guidance as to what methods of disposal he is to approve. It might be helpful if reasonable guidance were provided, preferably through a recommended regulation. The power of the State to intervene in the use of property without compensation is limited to means that are "reasonably necessary for the accomplishment of the purpose, and not unduly oppressive upon individuals." [29] That statement is from an 1894 case, but it has recently been repeated by the Supreme Court.[30]

[29] *Lawton* v. *Steele*, 152 U.S. 133 (1894).
[30] *Goldblatt* v. *Hempstead*, 369 U.S. 590 (1962).

Conclusion.

I have discussed the relationship between Federal and State regulation of commerce. I have particularly considered the extent to which Federal statutes preempt State law, and the extent to which the constitutional doctrines of due process and undue burden upon interstate commerce may serve to limit State regulatory power over the flow of commerce. I have also considered constitutional limitations upon the exercise of special police power, particularly recent developments with respect to search and seizure.

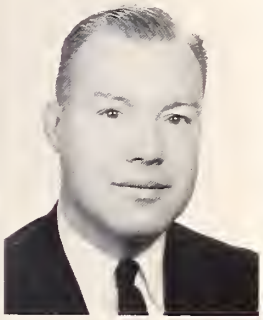
I hope my remarks will be of assistance to the members of the Conference, as you work to achieve national uniformity in weights and measures for the benefit of both buyer and seller, and for the encouragement of the free flow of commerce throughout the Nation.

MORNING SESSION—WEDNESDAY, JULY 13, 1966

(J. F. True, *Chairman*, Presiding)

SEMINAR ON DISCRETE AND CONTINUOUS WEIGHING SYSTEMS

Chairman: A. R. Parsons, *Marketing Manager, New Products Division, Honeywell, Inc., Minneapolis, Minnesota (President-Elect, Instrument Society of America)*



Introductory Remarks:

With such rapid progress being made along all technological fronts in the mid-1960's, it is no surprise that the ancient art of weights and measures is feeling the impact of technological changes. Change there is from a technological point of view, but the importance of weighing and measuring to the economy was recognized in this Nation 140 years ago when John Quincy Adams, before he became our fifth President, said:

> Weights and measures may be ranked among the necessaries of life to every individual of human society. They enter into the economical arrangements and daily concerns of every family. They are necessary to every occupation of human industry; to the distribution and security of every species of property; to every transaction of trade and commerce; to the labors of the husbandman; to the ingenuity of the artificer; to the studies of the philosopher; to the researches of the antiquarian; to the navigation of the mariner, and the marches of the soldier; to all the exchanges of peace, and all the operations of war. The knowledge of them, as in established use, is among the first elements of education, and is often learned by those who learn nothing else, not even to read and write. This knowledge is riveted in the memory by the habitual application of it to the employments of men throughout life.

We can paraphrase President Adam's words in contemporary terms by listing such important uses of weighing in industry and commerce as:

1. Materials accountability.
2. Process throughput control of raw materials, semifinished, and finished goods.
3. Proportioning and batching in production processes.

4. Filling and packaging operations.
5. Checking and inspection procedures.
6. Testing programs.
7. Merchandising.

Along with the expanding needs for a variety of weighing equipment has come the requirement for increased precision, reliability, and speed. The needs have been, and will be, satisfied by a multiplicity of mechanical, electrical, and electronic weighing systems and their associated instrumentation and control. Such space age developments as miniature strain gage and load cell sensors, digital readout, special purpose computer circuits, electronic scales, and continuous conveyor belt scales have fulfilled the more demanding weighing requirements of industry; but they have added also a variety of sophisticated mechanisms to a field not prepared for this technology advance. In recent years, there has been a growing awareness among users and designers of weighing equipment of the need for more information concerning its design, application, and calibration.

The demand for data and engineering information to facilitate understanding, and to develop uniform standards of design, application practices, and testing procedures has come from industry and commerce as well as from municipal, State, and Federal Government agencies.

The unique capabilities and experience of the Office of Weights and Measures, National Bureau of Standards, and the Instrument Society of America through its Standards and Practices Department, blend neatly together for the purpose of organizing the means for meeting the information and educational needs of industry, commerce, and government.

The *Office of Weights and Measures* functions in the following fields of reference:

1. Technical services to the States and to business and industry in the area of measurement.
2. The design, construction, and use of standards of weight and measure and of instruments associated with such standards.
3. The development of testing equipment and techniques.
4. The consideration of measurement problems.
5. The training of State and local officials in the technical aspects of weights and measures programs.
6. The collection, arrangement, and dissemination of data on units and systems of measurement, and on standards, testing equipment, procedures, and technical investigations.

The *Instrument Society of America* is dedicated to advancing the knowledge and practice related to the theory, design, manufacture, and use of instrumentation, controls, and data processing equipment in various scientific, technological, industrial, and community applica-

tions. Its *Standards and Practices Department* studies technical practices in instrumentation and prepares and recommends uniform practices where the adoption of such uniformity will simplify work, facilitate general understanding, and promote the interchange of information. Although ISA has organized and participated in similar cooperative programs with other professional societies and government agencies in the past, it is a special privilege to work together with the Office of Weights and Measures in an activity in which we have such a mutual interest, and through which such a significant contribution can be made.

This morning's session will cover the subject of *Discrete Weighing Systems* during the first segment of the morning, *Continuous Weighing Systems* in the second part, followed by a panel of distinguished speakers who will lead a general discussion until the conclusion of the session. Our speakers—all from industry—either in the field of designing and manufacturing weighing equipment or its use in production processes, will cover the basic fundamentals and a variety of specific examples related to the design and engineering, application, and calibration of weighing equipment. These papers will certainly bring us all to a common base of understanding of the technological progress in weighing systems. However, it is our hope that they will also stimulate questions and comments from you who represent the application of weighing systems in day-to-day usage. We look forward to hearing your candid reactions and opinions, in addition to the questions, during the Panel Session.

Mr. Jensen and I are optimistic enough to expect this morning session will produce:

1. An audience more familiar with the fundamentals and applications of modern weighing systems.
2. A few manufacturers who have learned the real needs of the users.
3. A plan by which the Office of Weights and Measures and the Instrument Society of America might better serve the needs of industry, commerce, and government agencies in the field of weighing.

(1) DISCRETE WEIGHING SYSTEMS

Moderator: R. H. Damon, *Research and Development Director, Fairbanks Morse, Inc., St. Johnsbury, Vermont*

Introductory Remarks:

The presentations we are about to hear are on a subject that may seem somewhat in the line of wishful thinking to some of us, and may seem to be of little value in commercial weighing to others but, if we have these thoughts, we must identify the most important single commodity any of us have—that of *time*.

We are about to enter the era of the supersonic transport, which will have the capability of crossing the Continental United States slightly in excess of one hour. Why? The only reason is to save *time*. Even such a monstrous undertaking, in terms of engineering and research required to obtain the product, and the cost of operating such a vehicle, is justified simply because so many people are willing to pay a premium to save a little more than three hours out of their day.

This is a far cry from 1775, when it took John Adams 2½ weeks to travel from Boston to Philadelphia—traveling 8 to 9 hours on most days.

Ever since John Adams' time, or shortly after it, our Nation has been the leader in the nearly worldwide obsession to save time. Those of us who are allied with industry have seen the growing urgency for increased efficiencies (less time), and the greater demands on our technical personnel (less time). There is every reason to expect that this urgency will reach even further than it already has into our field of industrial and commercial weighing in the not-too-distant future.

These additional demands will be in the nature of weighing in motion.

For a basic review, we recognize three areas of weighing in motion—these are bulk material weighing systems, weighing of moving railroad cars or highway vehicles, and weighing of inert or passive objects while they are in motion. The first area—you recognize the belt conveyor scale as the exponent of this approach—will be covered in the second session of this seminar. The second area is one that has received considerable attention from the railroads and a good degree of success has been obtained by the scale industry in meeting present requirements. However, these vehicular loads are supported by the vehicle springs—which introduces a set of random factors not present in the third area—the weighing, in motion, of the passive object.

Each of these three areas has been developed to the present state of the art because of the need to economize on our old friend (or enemy!) *time*.

It is the intent of all of us to insure that buyer and seller alike are protected to the full extent of the law when a commodity is sold by weight. All of our legislation concerning scales is directed at the performance of a machine and does not consider the human factor at all. This might be considered a paradox as we all know that "to err is human" and that by neglect or by design, weighing equipment that is in good condition can be operated to the detriment of either the buyer or the seller. Motion weighing comes closer to consumer protection because the human element is no longer present—the dial is not misread by accident, or the butcher's thumb is not part of the sale.

From all indications we in the industry have seen, our efforts will be directed more and more towards less handling of materials, towards more prepackaging and containerization, and to furnishing equipment to legally weigh random goods without the necessity of halting the steady stream of production that is a vital element of our economy.

The term *legally weigh* was used deliberately. At present, there is no legislation that recognizes the fact that a commodity is in motion at the time it is being weighed. This is the purpose of this seminar; to examine the variables which surround and obscure the facts of motion weighing, so that we may, at some future date, provide means by which the consumer and producer alike will be treated with equity, and benefit from the saving of time that the weighing industry can provide.

(*A*) ENGINEERING AND DESIGN

by J. G. Green, *Research Engineer, Fairbanks Morse Research Center, Beloit, Wisconsin*

Introduction.

Motion-weighing is a very broad concept which can conceivably be considered to embrace the weight-derivation of any matter in motion, whether it be a solid, a liquid, or a gas; from the electron revolving about the nucleus of an atom to the flight of a spaceship in celestial orbit. It would seem, then, rather logical to first define the boundary limits within which this subject will be related; that of weighing discrete, inert objects in motion. One of the dictionary definitions of "inert" is: "not having the ability to move itself," a definition which seems most appropriate for this subject. By virtue of this

definition, such objects as a motor vehicle moving along a highway, or a freight car moving down the hump of a railroad classification yard, are excluded from consideration. A "discrete object" is defined as one constituting a separate entity. For weighing purposes, a discrete object may consist of a single box or carton, or it may consist of several boxes on a single pallet, the total weight of which is desired. Therefore, motion-weighing within the confines of these definitions can be illustrated by a weighing system in which an object is carried on a motorized conveyor, is transferred to a motorized conveyor mounted on a weigh-platform, is weighed, and is then transferred to a discharge conveyor or chute. Furthermore, the term "weighing" as herein used, is the derivation of the true weight of an object and not a classification weight as derived in an "over-under" system.

Weighing systems must keep pace with the other advancements being made in manufacturing. Industry today no longer can tolerate the time-consuming luxury of weighing on slow-responsive mechanical-beam and pendulum-dial scales. The demand is for faster weighing procedures, and this demand can be, and is being, met by motion-weighing. Along with the demand for faster weighing procedures have come the requirements for more and more sophisticated automatic controls and data processing instrumentation. Weighing devices can no longer be treated as simple self-embodied weighing and indicating scales, but instead must be considered as part of the production flow-pattern of the complete producer-consumer cycle. With the advent of automatic systems has come a decrease of supervisory control, and weighing systems today are frequently called upon to operate over extended periods of time with no weighman in attendance. Under such conditions the problems involved in accurate weighing have become much more severe and scale manufacturers, as well as others interested in weights and measures, have had to reconsider many of the "old stand-by" rules and reevaluate them in the light of the ever rapidly changing weighing techniques.

Motor-weighing, by its own descriptive nomenclature, defines a system operating in a time-domain. Weighing systems operating on a second, one-tenth second, and 10 milliseconds time base for weight derivation are not uncommon, and systems capable of weighing in microseconds of elapsed time are entirely feasible. Mechanical weighing systems—that is, levers, beams, and pendulum mechanisms—do not have the high speed of response needed to weigh in these very small time bases, so most motion-weighing installations employ some form of transducer to convert mechanical force to electrical output. One of the most popular type of transducer is the bonded strain-gage load cell and future use of the terms "transducer" and "load cell" will be understood to mean the strain-gage type.

Most automatic motion-weighing systems can be broadly blocked-out into five basic functions which serve to define the system. Each

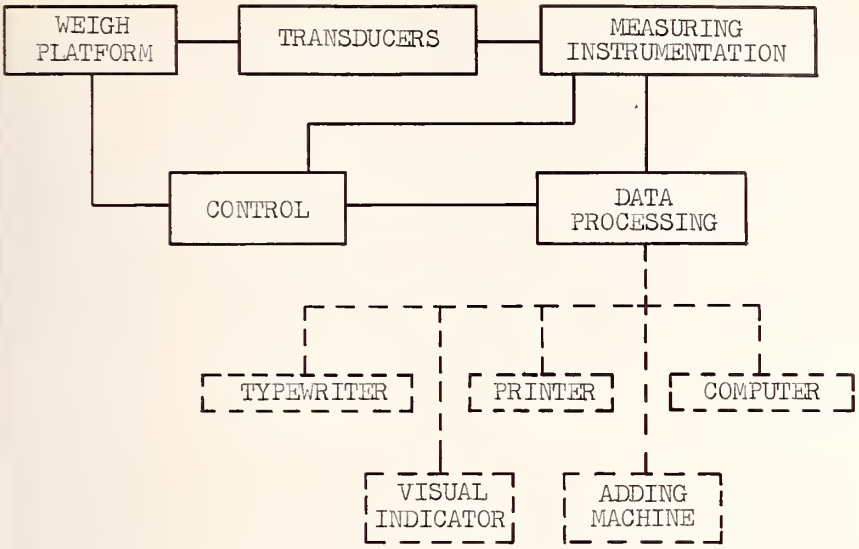


FIGURE 1. *Block diagram of automatic motion-weighing system.*

of these functions are illustrated on the block diagram of figure 1, as: (1) Control, (2) Data Processing, (3) Measuring Instrumentation, (4) Transducers, and (5) Weigh-Platform.

Control.

The control functions of the complete weighing system are under the command of the master sequencing circuitry. The master sequencer issues the instructions to interrelate the various timed events of the system. As an example, an object being weighed may interrupt a light beam when the object has advanced to a specified position on the weigh-platform, and in so doing, initiate the measuring cycle. The master sequencer accepts the signal produced by the interruption of the light beam and programs the instrument to measure the weight of the object. After the information has been derived, the master sequencer then instructs that the data processing phase be carried out. The data processing requirement may be the very simple one of merely entering the weight information into a printer, or it may be a more complicated one requiring the use of more elaborate, sophisticated time-sharing data processing equipment. Upon completion of the data processing cycle, the master sequencer then re-establishes the timing circuits preparatory to accepting the next object. Mechanical gates for spacing the flow of objects over the weigh-platform, and diverting gates on the discharge side of the weigh-platform, as well as memory devices and other production control equipment, are time-related to the measuring cycle by means of the master sequencer.

In most commercial weighing installations the design of the control system must be engineered for the job. Rarely is a so-called "off-the-shelf" system suitable. Since the design of the control system only indirectly affects the weighing accuracy, and only then in the event of a circuit malfunction, the important design considerations are those related to cost, reliability, and sequencing speeds. In instances where the maximum number of weighings per unit time is important, then the very fast switching times of solid-state components may be the only answer, whereas in other cases relays, stepping switches, and other similar control devices may be most advantageous. In all design formulations, the economics of the system components must be balanced against the engineering excellence desired.

Data Processing.

Data processing is strictly related to the requirements of the overall system and not to the weighing portion alone. It is a matter of, "now that you have the weight figures, what do you want to do with the information?" No one weighs an object just for the fun of doing it, but rather to use the information for some specific purpose. In industry this information may be necessary to expedite or control some manufacturing process or material-handling requirement. In the past, a scale manufacturer's responsibility was to provide an indication of the object weight and at most, to give a printed record of the weight, but with the advance of science on all fronts, such simple weighing systems are no longer adequate.

Most data processing systems today depend upon some form of digital coding. Digital coding offers several advantages. One of the most important being the ability to transmit and mathematically manipulate the information without error. Weighing instruments are, therefore, of the direct digital type, or a means is available to convert the analog information to digital. A pendulum-dial scale, for example, may have an analog-to-digital conversion mechanism mounted on the dial indicator shaft to provide the desired digital output. Translation matrices are available to convert any coded system into any other coded system so the design problem of interfacing the weighing instrumentation with any commercially available data processing equipment presents no particular problem. Assuming that the information taken from the weighing instrument is correct, then the transmittal and manipulation of this data to and through data processing equipment can be handled virtually error-free.

Measuring Instrumentation.

Mechanical lever systems, beams, and pendulum-dial scales were the work-horses of industrial and commercial weighing for many, many

years. The demands for faster weighing procedures, automatic controls, and data processing soon made evident that these mechanical devices were inadequate for the requirements. The mechanical scale required too much hime to come to a balance condition so the direction of development turned toward electronics. Weighing times of three seconds or more permitted the use of Servomotor-driven null-balancing bridge networks in association with load cells. Such systems, being electro-mechanical in nature, were more than adequate to meet this time requirement. However, as it became evident that weighing times of one second, one-tenth second, and even milliseconds would be needed to integrate weighing into the new industrial processes, new concepts in weighing instrumentation were developed. As a result, several new designs have made their appearance in the past few years. These new instruments are almost entirely electronic in order to take advantage of the higher switching speeds offered by electronic circuitry.

Electronic weighing instruments are essentially digital voltmeters. The signal fed into the instrument is a voltage whose magnitude is proportional to the weight of the object on the platform. The instrument measures this voltage to produce a digital indication and output. There are several different principles employed to convert the voltage to a digital output, among which are the following:

(a) *Ramp Type.*—An unknown voltage is compared to a linearly-increasing voltage called a "ramp." The time required for the ramp to rise from a fixed reference voltage to a value equal to the unknown voltage is a measure of the unknown voltage.

(b) *Voltage to Frequency.*—The unknown voltage is used to control an oscillator whose output is a series of pulses in which the frequency of pulses is proportional to the value of the unknown voltage. By counting the generated pulses over a precisely controlled interval of time, the value of the unknown voltage is determined.

(c) *Step-Voltage Type.*—A series of independent reference voltage steps is provided in digital, digital-decade, binary, or binary-decade sequence to which the unknown voltage is compared. By comparing the unknown voltage to the reference voltage steps in sequential order, the value of the unknown voltage is established.

(d) *Voltage-Divider Type.*—In this method, the unknown voltage is compared to a voltage derived from a series array of precision resistors across a very stable reference voltage source. Many configurations of the precision resistors values may be employed, such as binary, binary-decaded, or digital-decaded.

Each type has advantages particular unto itself. No one instrument is universal in its application and each has a place in the general scheme of motion-weighing. Measuring times as low as one millisecond and up to ten seconds can be chosen from among these various

types. Instrument accuracies of 0.01 percent or better are possible with the types mentioned. A wide choice of instrumentation is, therefore, available from which the one most suitable in regard to measuring time and acuracy can be chosen to meet the particular requirements of a particular motion-weighing installation.

Transducers.

It is the function of the transducers to change the gravity-weight of the object being weighed into a proportional voltage output which can be measured by the instrument. There are several different types of transducers being employed in weighing systems today, such as, pneumatic, hydraulic, and electrical. Among these, one of the most popular types is the bonded strain-gage load cell. Strain-gage load cells have been manufactured in sizes varying from ounces-full-load rating to twelve-million-pounds full load rating now in use at NASA. Strain-gage load cells have several advantages in motion-weighing installations since they have very fast response times, are compact, are not subjected to wear, and, since the output is electrical, the coordination with other control equipment is quite straight forward.

The acuracy of the overall motion-weighing system is dependent, in large measure, on the characteristics of the load transducers. If the output of the transducer is in error with respect to the applied load, the most perfect measuring instrument will indicate a system result that is in error. Linearity of voltage output with respect to applied load on strain-gage load cells is normally 0.1 percent for most weighing applications, with some special applications using load cells of 0.05 percent linearity. Variations in ambient temperatures in the vicinity of the load cells can cause errors in the output voltage. Most load cells are temperature compensated, but usually only in the range of +15°F. to +115°F. Many weighing applications exceed these temperatures in both extremes. Changes in barometric pressures also can cause an error in the output voltage of load cells and some manufacturers have included in their designs means to compensate for such pressure changes. Since strain-gage load cells are usually of the wheatstone-bridge resistive configuration requiring an input voltage to produce the output voltage, it is most essential that well regulated power supplies be employed. The extra effort and cost required to provide excellent load-cell power supplies is more than paid for in the stability and accuracy achieved.

It is evident that if a motion-weighing system is to approach a 0.1 percent accuracy, and if load cells of even 0.05 percent linearity are used, and if the accuracy is to be maintained over an extended period of time, then many design complexities must be introduced into the system. Unfortunately, as design complexities increase, the cost of the system increases, and reliability decreases. Reliability can be restored through deliberate redundancy, but at a further increase in cost.

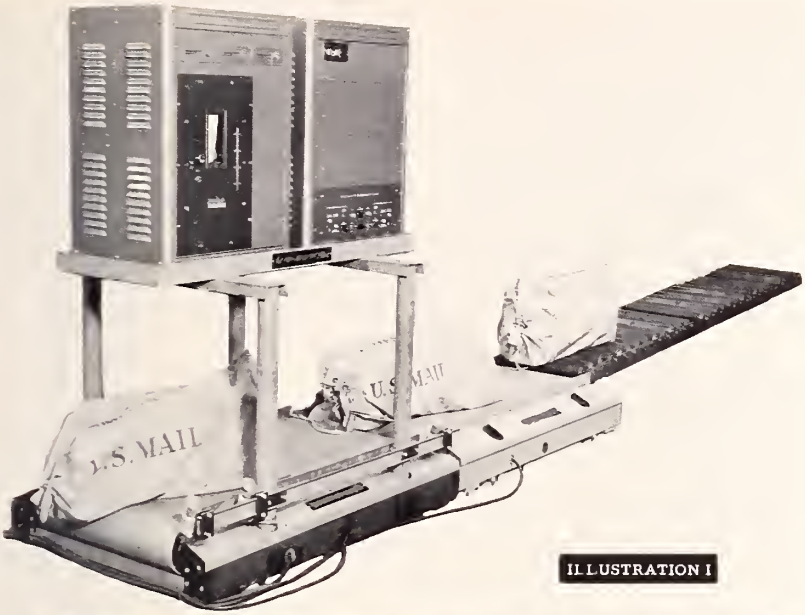


ILLUSTRATION I

HIGH SPEED WEIGHING UNIT COMPLETE - WITH PICKUP CONVEYOR

Weigh-Platform.

Aside from the influence that the choice and application of the load cells have on the overall accuracy of a motion-weighing system, the most important problems center about the design of the weigh-platform. In fact, as a design problem, the load cells and the weigh-platform must be considered as a unit since the problems of one are directly related to the other. Many motion-weighing scales are designed so that a complete belt-conveyor system is mounted on load cells; the conveyor then becomes the weigh-platform. The objects to be weighed are brought to the scale by conveyors, are transported across the scale platform by the weigh-conveyor, and are then carried away by other conveyors. In such systems, it is common to include all necessary components of the weigh-conveyor, such as drive motors and reduction gears, as an integral part of the conveyor, so that the entire dead weight of the conveyor is carried on the transducing system.

Because most motion-weighing scales are part of a more general system, and because many of these have special design features to meet a customer's particular requirement, it is not always possible to thoroughly check out the completed design in a laboratory before installation in a customer's plant. No amount of laboratory testing can duplicate the environmental and dynamic conditions under which the scale will be operating in day-in, day-out service. In order to illus-

trate how certain design modifications to a weigh-platform improved the overall system accuracy, the results of a series of field tests are herein included and discussed.

Illustration I is of a high-speed motion-weighing scale installed in the field early in 1963.

Instrument: Single-Sample Ramp System-Electronic.

Scale Capacity: 100 pounds.

Indication: Digital, 99.9 pounds maximum reading capacity, 0.1 pound minimum graduation.

Measuring Speed: One-tenth second maximum.

Readout: Parallel entry into totalizing adding machine.

Conveyor: Belt conveyor operating at 120 feet per minute.

Trigger Device: Photocell.

Transducers: Four strain-gage load cells.

Installation and Operation: The scale is located between the end of a production line and the shipping dock. Packaged production items are randomly placed on a continuous conveyor belt traveling at 75 feet per minute. They are discharged onto a short length of speed-up conveyor traveling at 120 feet per minute. This exchange performs the desired separation between items. From the speed-up conveyor the items are transferred to the weigh conveyor. When the item is fully scale-borne, and at a point near the discharge end of the weigh conveyor, a photocell light beam is interrupted, triggering the weigh cycle. Upon completion of the weigh cycle, the item weight is displayed on the digital indicators and is also automatically entered into the parallel-entry adding machine. The result is a printed record of each individual item. Available to the shipping dock foreman is the facility for pulling out a subtotal or total for each production run as desired.

In order to appreciate some of the salient points brought out by the mathematical treatment of the test data herein presented, the conditions under which the weighing system operated are worthy of consideration.

1. The instrument is digitally indicating with a minimum graduation of 0.1 pound. This is equivalent to 1.6 ounces, and if this 1.6 ounces is placed anywhere on the weigh-conveyor (having a total surface area of 8 square feet), either concentrated or evenly distributed, the scale will indicate this change in load. It is not difficult to visualize the many ways in which the force acting upon a moving conveyor can change by the very small amount of 1.6 ounces, particularly on a system operating under dynamic conditions associated with full production.

2. This particular system is fully-automatic with no weighman in attendance. It is a "command" device, its weigh-cycle being initiated by the object being weighed. Consider a static weighing scale under the operation of a weighman when a fork lift truck

is passing by. If the truck should induce a vibration into the scale mechanism and the scale indicator oscillates about the balance point, the operator merely waits until the truck has passed and the indicator has settled out before reading the weight. This privilege is not allowed an automatic device for it must weigh on command, reset itself, and be ready for the next object following closely behind. On a production line, there is no stopping except in the case of emergency.

3. In this particular installation, a further complication was introduced by the chimney effect of a discharge chute. After the object was weighed and printed, it was discharged from the weigh-conveyor into a spiral chute that carried the object down to a lower level shipping dock. Under certain atmospheric conditions, there would be a draft up the chute and across the weigh-conveyor sufficient to cause a change of 10 graduations or more on the scale indicators. The scale responded to the force created by the flow of air across the conveyor.

4. As mentioned previously, the instrumentation of this installation employs the ramp principle; that is, a linearly increasing voltage is compared to the load-cell voltage output and the time required for the two voltages to reach coincidence is indicative of the weight on the weigh-conveyor. The instrument is, therefore, a single-sample device. It does not average in the manner of the integrating principle, nor does it average in the manner a 10-sample system would. It is reasonable to expect that an improvement in accuracy could be achieved by use of either of the latter two methods. However, one-tenth second allows very little time for integrating averaging, and vibrations below 10 cycles per second will not allow even one full cycle for averaging. In a 10-count averaging system, to hold a total measuring time of one second would require each sample of measuring time to be 10 milliseconds or less.

Test Procedure.

Because the scale was installed in a production line operating on a three-shift-per-day basis, it was necessary to make all dynamic tests in conjunction with the production runs. Changes and corrections to the scale could be made only during infrequent down-times or weekends. It was desired to run the tests at three specified weights of approximately 30, 50, and 75 pounds. Three mail sacks were loaded with magazines and then were weighed very accurately on a beam scale by the substitution method. The weight of the sacks turned out to be 32.4 pounds, 49.5 pounds, and 70.9 pounds. These sacks were kept intact and used in all tests, thus becoming so-called secondary standard weights. Under the conditions existing for making the tests, mail

sacks were much more convenient to handle than cast-iron test weights and a lot safer for the personnel involved. The procedure was to insert the test bag into the production run about 25 feet ahead of the weigh-conveyor, allow it to pass over the scale where it was weighed and recorded, catch it just as it left the weigh-conveyor and before it disappeared down a chute, then reinsert it into the production line to repeat the weighing process. Literally thousands of weighings were made in this manner and the results subjected to statistical analysis. Rather than include a mass of data which would only serve to cloud the issue, the results of four significant tests using the 49.5 pounds test sack will be discussed.

Design Modifications and Test Results.

Test No. 1.

Test Sack—49.5 pounds.

Before the start of the test, the scale was statically checked with calibrated test weights in 5-pound increments and was found to vary by not more than 0.1 pound (or one graduation) over its entire capacity range.

One hundred weighings were made and a histogram of the results is shown plotted in figure 2. The class interval selected for this histogram is 0.1 pound simply because this interval corresponds to the valuation difference of one graduation. Figure 3 is the Gaussian distribution curve derived from the data and on it are shown the pertinent statistical results. It is seen that the average weight is 48.99 pounds or 0.51 pounds low with respect to the test sack of 49.5 pounds. The one-sigma deviation was 0.278 pounds, and, with respect to a plus/minus 0.1 pound tolerance on the test sack, only 6.5 percent of the weighings could be expected to fall within this tolerance band. There was a range of 13-class intervals from low to high weight readings.

In themselves, these figures have little significance, other than to verify the obvious conclusion that the scale was not doing a good job. However, these statistical figures will become more meaningful in the light of subsequent results. It would not take a mathematician to conclude from the results of this test that something was wrong. Here was a scale that statically weighed within a tolerance of 0.1 percent, yet its dynamic average was 0.51 percent in error, and its dispersion of data ranged from 0.7 percent to 0.6 percent high from its average.

As a result of several tests under the various conditions of loading, all of which statistically told essentially the same story, it was decided an engineering change was called for. Several reasons were suggested for the cause of the trouble, such as slow dynamic instrument response, but as each suggseted cause was investigated, the finger of guilt pointed

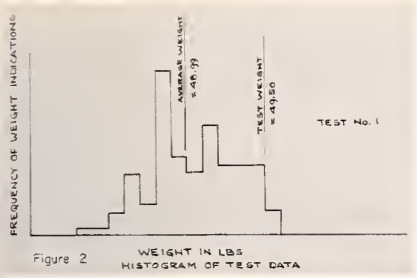


Figure 2

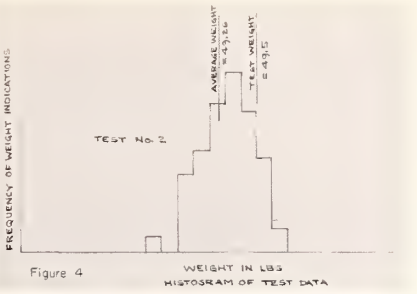


Figure 4

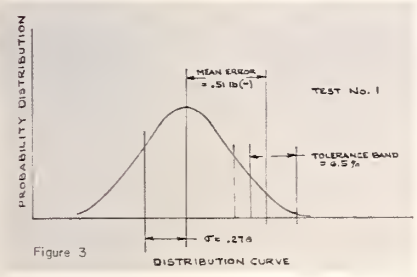


Figure 3

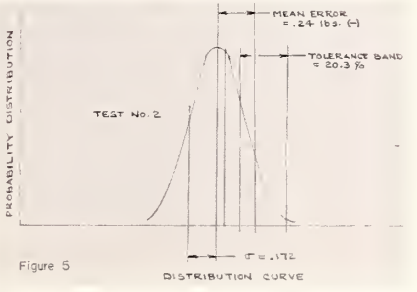


Figure 5

more and more to the weigh-conveyor. A change in the weigh-conveyor assembly was made to provide a smoother traverse of the test sack over the conveyor length and another test conducted.

Test No. 2.

The same test sack of 49.5 pounds was used in Test No. 2 as in Test No. 1. Before start of the test the calibration was checked with calibrated weights and no error exceeded one graduation, or 0.1 pound.

One hundred weighings were made and a histogram of the results is shown plotted in figure 4. A comparison of figure 4 with figure 2 shows a visual improvement of the scale system, in that the range of values has been reduced from 13-class intervals to 9, illustrating a tendency of the individual weighings to group more closely about the arithmetic average.

Figure 5 is the distribution curve of the data of Test No. 2. The average weight was 49.26 pounds, or an error of 0.25 pound lower than the test sack. The one sigma deviation was 0.172 as compared to 0.278 of Test No. 1, which is a considerable improvement. The percentage of weighings expected to fall within the plus/minus 0.1 pound indicating range has risen from the 6.5 percent of Test No. 1 to 20.3 percent in Test No. 2.

The calculations now have a meaning in that any changes in test results can be mathematically related in a unit of measures, rather than the customary expressions of "a little bit better," or "a whole lot better." Lord Kelvin is quoted as saying, "when you can measure what you are speaking about and express it in numbers, you know something about it . . ."

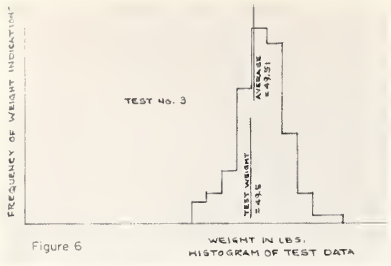


Figure 6

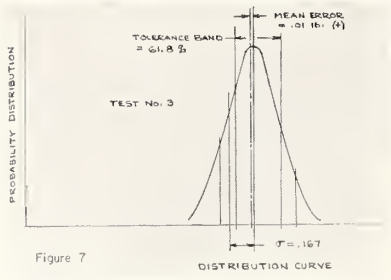


Figure 7

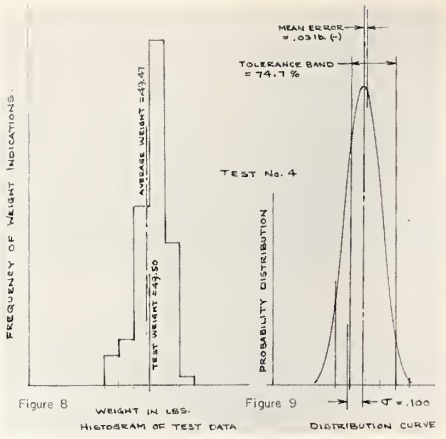


Figure 8

Figure 9

The changes made to the conveyor resulted in an improvement to the system, but the average weight was still on the "low" side. Attention was next directed to a redesign of the check-link assemblies of the conveyor. New check-links were made and installed, and a new series of tests were run.

Test No. 3.

Using the same test sack of 49.5 pounds, and being assured by calibrated weights that the scale was statically within the plus/minus 0.1-pound tolerance, the plot of 100 weighings is shown on the histogram of figure 6. Figure 7 is the distribution curve of the 100 weighings. The average weight of this test was 49.51 pounds, or only 0.01 pound high with respect to the test sack weight. The range was 10-class intervals; better than Test No. 1 and about equal to Test No. 2, which was 9-class intervals. The one-sigma deviation was 0.167, only slightly better than Test No. 2, but the expected percentages of plus/minus 0.1 pound in tolerance weights had risen to 61.8 percent from the 20.3 percent in Test No. 2.

The redesign of the check-links resulted in a substantial improvement in that the weighings almost equally bracketed the test-sack weight, the average weight was only 0.01 percent in error (based on full-capacity load), and the in-tolerance percentage had improved by 41.5 percent.

The results of Test No. 3 were quite encouraging so a further modification of the checking system was tried. The orginal design consisted of four plate-fulcrum type check-links, one at each corner of the conveyor. The final change consisted of removing the two check-

links on the downstream end of the conveyor and using only the two check-links on the approach end as the restraining members. This change permitted the conveyor assembly to realign itself under varying operating conditions with the following results:

Test No. 4.

Using the same test sack of 49.5 pounds, and with the scale in static calibration plus/minus 0.1 pound maximum error, the plot of 100 weighings is shown on the histogram of figure 8. The distribution curve of the 100 weighings is shown on figure 9. The average weight was 49.47 pounds or 0.03 pound low with respect to the test sack weight of 49.5 pounds. The one sigma deviation improved to a factor of 0.100 with the resulting improvement of the expected in-tolerance weighing of 74.7 percent. As a matter of interest, 95 percent of the weighings would be expected to fall within plus/minus 0.2 pound.

Summary.

To achieve an acceptable accuracy in motion-weighing is more of a mechanical design problem than one of electronics. Measuring instruments can be chosen from the several different types whose accuracy is compatible with the available measuring time. Motion-weighing introduces many mechanical problems not experienced in static weighing systems, and motion-weighing equipment must operate under environmental conditions over which they have little or no control.

It is axiomatic that a static calibration test on a motion-weighing system is of little value in predicting the accuracy to be expected under dynamic conditions. Because of the nature of motion-weighing and because dynamic operation induces extraneous forces that static scales are not subjected to, it is hardly to be expected that, under continuous service, motion-weighing will always meet the same standards of accuracy as static scales. For these reasons and because many motion-weighing installations require only a total weight figure, or an average weight, the following proposal is introduced as a topic for future discussions:

Proposal.

An acceptance requirement of a motion-weighing installation should be predicated on a statistical evaluation derived under dynamic conditions. It would seem logical that the one-sigma, two-sigma, and three-sigma deviations be specified and that the mean value be related to the true value by a statistically calculated mean error.

(B) APPLICATIONS

by D. B. Kendall, *Manager, Custom Engineering, Toledo Scale Corporation, Toledo, Ohio*

Weighing has long been considered a necessary but time-consuming operation. Many transactions are based on the weight of material or objects, and, in many cases, workers are paid on the basis of the weight of material produced. These are commercial applications and weights and measures officials have jurisdiction over the equipment used. In addition, many weighing operations are performed in manufacturing processing operations and to determine plant efficiency, shrinkage of product and other factors. These are noncommercial applications.

Years ago when the beam scale was the only known method of obtaining accurate weights, the weighing operation was quite time-consuming and tedious, and the records available were quite primitive. With the introduction of automatic indicating scales, it was soon found that the speed of weighing operations could be increased and better methods of record keeping were developed for use with these scales. Scales were incorporated in conveyor lines, whether of the roller type or the belt type, by mounting a short section of roller or belt conveyor on the scale platform. In the case of overhead track conveyors, a section of the track was suspended from a lever system. Because of the time required for the scale indicating mechanism to come to rest in order to accurately measure the weight, it was common to stop the object on the scale or else move it very slowly across the scale. This type of equipment is generally limited to speeds of about 900 weighings per hour.

When the load cell was invented, it was soon realized that this instrument was capable of very high-speed measurement of weight. Much effort was put forth to develop the load cell to the point where it is now capable of measuring weight to commercial accuracies. Many of you are familiar with the conventional load cell scale where a potentiometer is driven by a servo motor to a position where the voltage output of the load cell is balanced in order to determine the weight of the load. Such a device cannot be made substantially faster than a conventional, mechanical automatic-indicating scale. The load cell itself is capable of very rapid response to the load upon it. The continuing demands of industry for methods of rapidly measuring weight forced the development of the high-speed weighing equipment described to you by Mr. Green. Besides dramatically increasing the speed of weighing, such equipment is easily adapted to transmit weight

and other information in a form readily usable by modern data recording and processing equipment, so it fills a need very important to modern industry.

There are many noncommercial applications of this type of equipment. The need of the U.S. Post Office Department to increase the speed in handling mail was an important factor in forcing early development of this equipment. Other noncommercial applications are the gross weighing of packages to determine that the desired components are all present, and the gross weighing of a number of packages to determine that an order has been properly filled. Rapid counting of parts by weight for inventory and determining shrinkage between departments can also be accomplished.

For commercial applications, net weighing is almost universally required. In order to perform commercial weighing operations, the following five basic requirements must be met:

1. Only one object must be weighed at a time.
2. Provision must be made for offsetting the weight of containers or wrapping material or devices used to suspend the object being weighed.
3. The object must be moved across the scale in such a manner that vertical forces other than weight will be held to an absolute minimum.
4. The object must be on the scale for a sufficient time to accurately measure its weight. If the object is swinging, or there are other causes for cyclic variation in the weight measurement, it may be necessary to have the object scale-bourne for a sufficient time to average the weight readings over a period of time.
5. There must be an adequate and accurate means for reading the weight measurement and either indicating or recording, or both indicating and recording, the weight value.

Two of the more common applications of weighing discrete objects in motion will be described. The first is the case where an overhead monorail conveyor is used and the second will be where the objects are conveyed on either a belt or roller-type conveyor.

Monorail Scales.

In the case of an installation for the weighing of hog carcasses suspended from a monorail and driven by a powered conveyor (fig. 1), a short section of conveying rail is suspended either from two load cells or from a lever system which is connected to a single load cell. The first requirement of weighing, only one object at a time, is accomplished by establishing the length of the weigh rail at a dimension less than the spacing between the pushers on the powered conveyor.

The second requirement of offsetting the tare is accomplished by adjusting the scale to read zero when a hanger is on the weigh rail. It obviously is important that the weight of these hangers be very uniform.

The third requirement of assuring absolute minimum vertical forces other than weight is accomplished in the design of the carrier and pusher to eliminate vertical components in the process of driving the carrier. Proper lubrication of the carrier wheel is an important factor in this application.

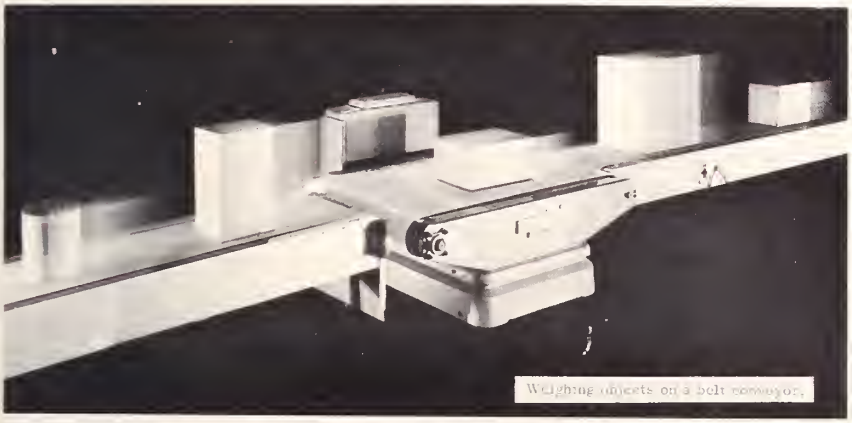
The fourth requirement of adequate time to perform the weighing operation is generally accomplished by a limit switch operated by the carrier a suitable time after it is scale-borne. The maximum time available is generally used to average the weight readings, so that the effect of swinging of the carcass or other oscillating forces is removed. Since the hangers are normally spaced at two foot intervals, the scale-borne section of rail can be up to about 21 inches long. Satisfactory weighing operations at speeds up to 1,200 per hour have been accomplished with this application. Under ideal conditions, it would be possible to weigh at 3,000 per hour.

The fifth requirement for suitable indicating and/or recording of the weight is accomplished by equipment that, besides showing the weight figure in digital form, can automatically enter predetermined supplementary information (such as the grade of the carcass, oper-

ator, and seller or buyer identification) into data recording and processing equipment. The total weight of different grades of meat, processed by specific operators for different sellers or purchasers, is accumulated to determine the pay for the operator and to make out a check for the seller or an invoice for the buyer. Controls can be provided to direct carcasses in selected weight zones to different processing areas.

Belt and Roller Conveyors. (Figure 2)

The first requirement of proper spacing of the objects to insure only one on the scale at a time can be met by proper spacing of the objects on a belt conveyor. For roller conveyors it is generally necessary to provide some indexing means. Using either a stop roller or stop fingers, packages on the main conveyor are stopped when they get to the entering point of the approach conveyor. When it is desired to



Weighing objects on a belt conveyor.

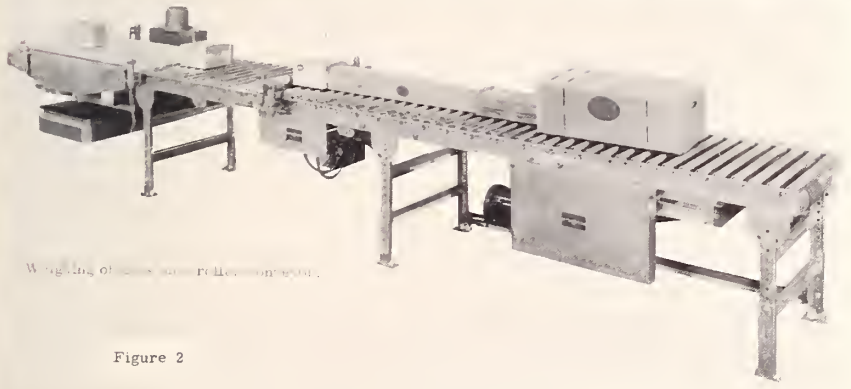


Figure 2

pass a package onto the scale, the stop is pulled down so that the next package can enter this conveyor. The approach conveyor runs at a higher speed than the main conveyor so that the package is separated from those following it, and the following packages are stopped. The package to be weighed is moved onto the scale by the approach conveyor, and when it is passed across the scale the next package is released.

The second requirement for offsetting tare weight can be accomplished, if the package or wrapping weight is uniform, by offsetting the tare on the scale. If packages have different tare weights, the scale can be adjusted for gross weighing. Tare weight information can be coded onto the packages and the tare weight subtracted in the data processing equipment.

The third requirement, of moving the package across the scale with minimum vertical forces aside from weight, is accomplished by the use of a belt conveyor with very carefully balanced components.

The fourth requirement of assuring adequate time on the scale for the proper weighing operation is accomplished by the proper design of the length and speed of the belt conveyor on the scale so the longest object will be fully scale-borne for a suitable time, and the use of photocells, as shown, or limit switches operated by the object being weighed, to start the weighing operation after any impact effect has subsided. Either a single instantaneous weight reading can be taken or an average weight reading can be taken over a specified time. Satisfactory weighing operations at speeds of 2,400 per hour are possible.

The fifth requirement of indicating and/or recording can be accomplished in many ways. Either the individual or total weight can be indicated by the weighing equipment. For recording and data processing, the weight information can be fed into an adding machine or tape punch. Various types of auxiliary information such as identification of lot or operator, customer or vendor, and date, or time and date can be entered along with weight. Computations can also be performed by various computers. One example is the case where parts are purchased or sold by number. In this case the weight and the number of parts per pound can be entered into a computer and the number of parts in a lot determined from the weight. Another application is that where such material as synthetic film is sold on a standardized moisture content basis. The weight, actual moisture content and a correction factor are fed into a computer. The weight corrected to the standard moisture content is determined and used for the buying or selling transaction.

Various applications of this high-speed weighing equipment have been described. The obvious question of how weights and measures officials can determine that both the buyer and the seller are treated fairly will be answered by the speaker who follows.

(C) TESTING

by B. Taylor. *General Manager, Exact Weight Scale Company, Columbus, Ohio*

Mr. Green has concluded with a series of histograms and distribution curves showing averages, standard deviation and other data. These are the end result of the testing procedures, and I would like to start a little nearer the beginning in terms of concepts and principles involved, hopefully arriving at the same conclusion as did Mr. Green. In addition, we should look at these statistics in the light of H–44 requirements and possible future standards of performance.

As Mr. Green and Mr. Kendall have pointed out, the equipment involved here is a system rather than a scale, and this introduces two new problems—one being material handling onto and across the scale, and the other the additional gear, electronic devices and such, that complete the entire system.

Handbooks 44 and 94 contain the procedures for scale testing and set up standards of acceptance. Usually, inspection does not indicate how good a scale is, but merely that it operates within allowed limits.

In-motion weighing is not as easy. It involves more detail, new criteria for performance, and it is complicated by the fact that systems are usually made for specific applications. There is no standardization as envisioned by H–94. Also, in the usual weighing devices, the inspector will be familiar with the mechanism (as H–94 suggests he should be) but the complexity of many systems may place the inspector at some disadvantage.

Figure 1 shows a relatively simple system, consisting of a scale, some control equipment, and a readout.

It could be much more elaborate, with perhaps a manual input, the transmission of data over long distances, and possibly into a computer. There could be feed-back from the computer to the scale, and so on.

In fact, one recently discussed system consisted of 1 percent weighing equipment and 99 percent electronics, which should please our friends in the instrument business.

As a first step in the examination of in-motion weighing systems, a more complete inspection is necessary. Here are some of the points that should be given special note:

1. Listing of the manufacturer's name, item description or model number.

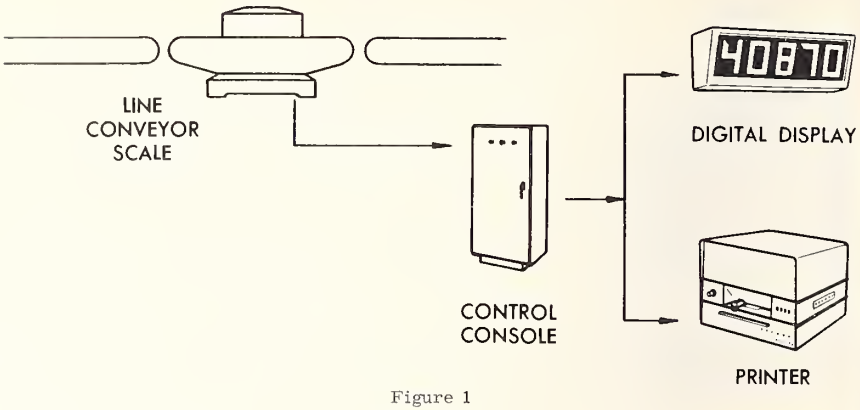


Figure 1

2. Capacity of the unit and normal weighing range.
3. A brief review of the system and how it works.
4. What is the type of weighing device and what is its identification?
5. How is the readout done and how is the readout device graduated? What is the readout device and what future use is made of the weight data through cards, tape, computers, etc?
6. What is the commodity size, shape, and range of weights?
7. How is the handling done, conveyor to scale, on the scale, and away from the scale?
8. In the weighing operation, how long is the item scale-borne? What is the product spacing and units per hour?
9. Are the ambient conditions satisfactory, such as air in motion with open windows or doors? Is there moisture, heat, cold, or dust?
10. In the matter of vibration, we have a problem of very great importance. Are there vibrations in the building structure and are they transmitted to the scale? Does it interfere with scale operation?
11. Is the material handling equipment durable, free of binds and friction and unaffected by interference from surrounding objects? Is the smoothness of transfer on and off the scale adequate?
12. Is there any evidence of improper use or inadequate maintenance?
13. Are wide variations in temperature possible?

As an introduction to the actual testing procedure, there are two major concepts that should be discussed.

The first of these has to do with the consistency of results: that is, the system "in control" or "out of control." The second main point in testing of in-motion equipment is the subject of probability.

Figure 2 is a mechanical system. It is relatively simple, with two components and a readout technique that is not very complicated. Furthermore, the system is "in control," by which we mean that the results can be predicted with mathematical accuracy.

For anyone thinking that this system is not amenable to prediction, note this frequency distribution in figure 3. With 36 possible combinations, note that there are 6 ways to get a 7, one way to get 12. So the pair of dice illustrates a system that is "in control" and has predictable results—the requisites of any good system.

But systems can go astray. Figure 4 shows one that has. Obviously, when compared with our standard, it is out of control and the probability does not match our standard either.

In the preparation of a chart to show test results, the total range is divided into 20 groups, which is a good rule of thumb, and the various readings indicated. With the columns blocked in, a histogram is formed which shows the pattern of weighments (fig. 5).

Figure 2

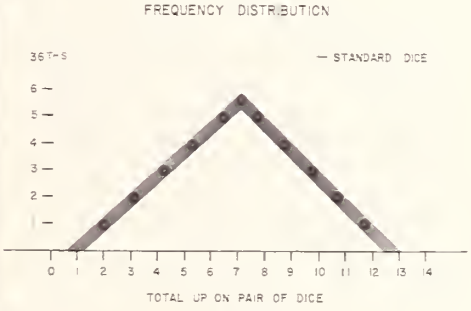


Figure 3

Figure 4

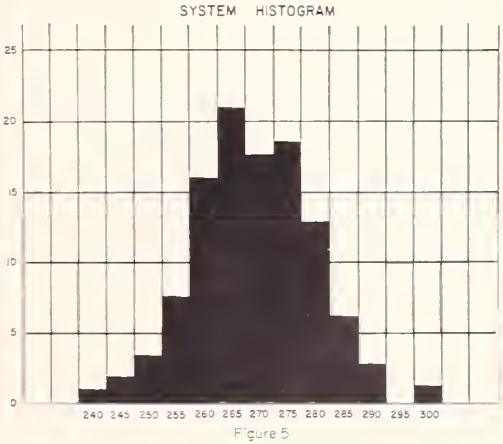


Figure 5

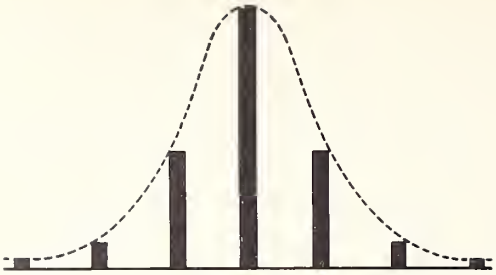


Figure 6

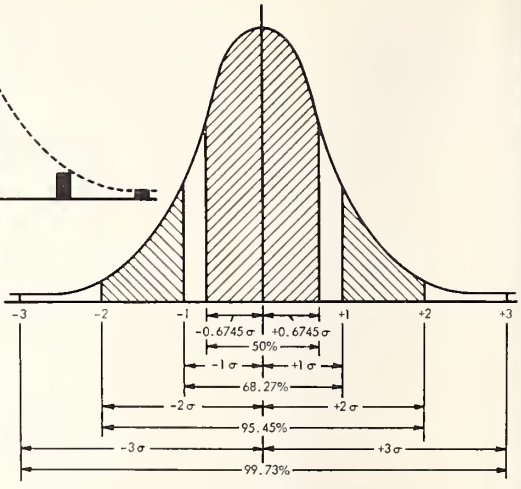


Figure 7

With a great number of tests, the tops of the histogram chart would form a curve. This familiar bell-shaped distribution chart is a very important working tool (fig. 6). Its shape, location, and spread are the criteria for testing.

The location of the midpoint (or average) should be determined, and some measure of the spread is needed.

Dispersion, or the spread of the curve, is described by the mathematical term "Standard Deviation" and this is defined as the root mean square deviation of the observed numbers from their average. A normal distribution curve has characteristics shown in figure 7 where 68+ percent of all of the test results will fall within ± 1 standard deviation, 95+ percent within ± 2, and 99+ percent within ± 3.

A good test is needed for at least 3 different points in the weighing range. (A commodity should be used similar to that regularly run.) To be accurate, a great number of weighments should be made, perhaps 200, and for a 350-pound load this might prove to be quite a task. On this form, space is provided for recorded data, for plotting it, and for calculating results. Figure 8 shows a completed test, with weight data shown and a chart plotted. Average is 372 pounds. Standard deviation is 3.1 pounds.

The shape of the histograms shows fairly good control, but the test average is low. Furthermore, there are three stray readings that indicate some sort of problem. Assuming that this first test was not satisfactory, some adjustments were made and a new series recorded (fig. 9).

EPO TEST

ACTUAL WEIGHT OF TEST LOAD 377 LBS.

TEST 1

TEST READINGS

375	372	372
372	372	369
375	373	379
376	374	378
370	373	361
370	371	371
372	372	373
370	372	372
370	372	370
370	371	373

CALCULATED AVERAGE 372

AVERAGE ERROR −5 LBS.

STANDARD DEVIATION 3.1 LBS.

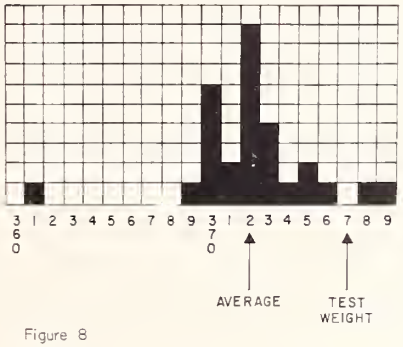


Figure 8

EPO TEST

ACTUAL WEIGHT OF TEST LOAD 377 LBS.

TEST 2

TEST READINGS

367	370	370
368	371	372
370	371	376
370	370	371
369	372	373
361	371	362
372	361	365
369	364	363
371	362	362
370	362	363

CALCULATED AVERAGE 368

AVERAGE ERROR −9 LBS.

STANDARD DEVIATION 4.2 LBS.

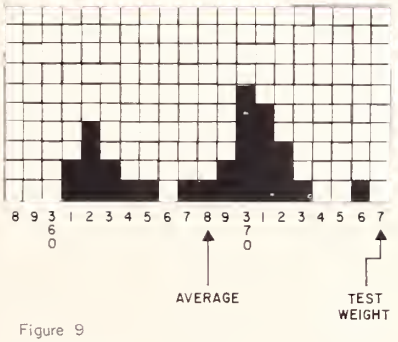


Figure 9

EPO TEST

ACTUAL WEIGHT OF TEST LOAD 375 LBS.

TEST 3

TEST READINGS

375	377	376
376	376	376
375	374	373
374	373	375
375	372	374
374	373	375
375	374	373
375	376	374
374	375	376
376	374	375

CALCULATED AVERAGE 375

AVERAGE ERROR 0 LBS.

STANDARD DEVIATION 1.2 LBS.

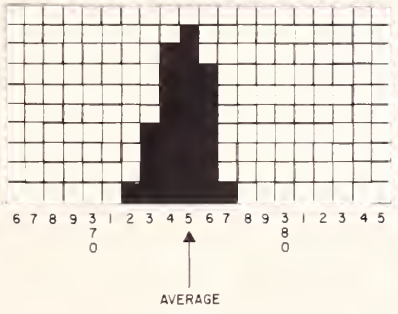


Figure 10

Obviously the fix was not very good. The average error is now 9 pounds, standard deviation is 4.2 pounds, and the histogram clearly shows an "out of control" condition. Normally this would be considered as a poor test.

For the next inspection, the test looks better (fig. 10). It will be noted that, as part of the reinspection, we checked the test load and found it to be actually 375 pounds.

Our average reading was 375 and standard deviation 1.2 pounds. Evidently, a good test was performed. So, taking this test data and showing it on a curve, we can say:

1. That the system's average error is less than 1 pound.
2. That 68 percent of all weighments will be within 1.2 pounds.
3. That 95 percent of all weighments will be within 2.4 pounds.

Or, if the system had a capacity of 1000 pounds, performance, reading to the nearest pound, could be stated as:

68 percent of all readings will be within .1 percent of full scale
95 percent within .24 percent of full scale.

To summarize, we have suggested three criteria for testing:

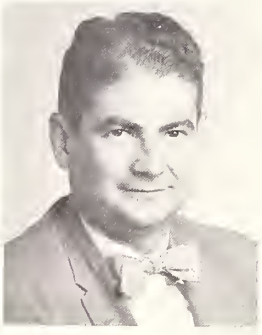
1. Consistency of test results (out of control).
2. Test averages.
3. Standard deviation.

Obviously, it is much easier to specify a test procedure than to develop standards of performance. As weighing systems come into "commercial" use, and as they become the responsibility of weights and measures officials, it will certainly be the job of NBS and this Conference to think about standards of performance.

(2) CONTINUOUS WEIGHING SYSTEMS

(A) ENGINEERING AND DESIGN

by R. J. Bierman, *Manager, International Division, Ramsey Engineering Company, St. Paul, Minnesota*



The basic justifications for weight measurement and control in the process industries have changed very little in recent years. However, the selection of specific equipments and suppliers has become more complex, due primarily to industries' more exacting demands.

With the advent of industrial data collection and processing, management has realized that more accurate data was required at the source. In order to accomplish these objectives, it has been necessary to maintain a closer control, and to measure the flow of raw materials more accurately, than ever before.

Let us examine the various factors in the flow of bulk materials which determine the need for accurate weighing and control.

The most incontestable index of material accountability is *weight.* It provides management and the accountant with the exact information that is required to establish a complete picture on the flow of materials to all operations. Weight is a more exact measure than—"a ship's displacement" or "number of carloads" or "so many truckloads." Weight establishes a standard that "bags," "containers," "trucks," and "ships" as unit measuring devices cannot provide with uniformity.

Weighing devices can be used in processes to control the throughput of raw materials and thus establish production rates. This permits engineering and production to size equipment for a predetermined throughput and to be able to maintain this production schedule to its maximum throughput.

Closely related to throughput control is the control of secondary materials such as other solids and liquids, all of which must be closely controlled to produce proper material balances. It has become quite common today to control the addition of one or more materials to the primary flow material at a predetermined accurate percentage. A good example of this type of control is found in a cement plant where clinker and gypsum may be blended, in a coal plant, where various grades of coal are blended, or in a steel mill in the feed to a blast furnace, where several ingredients are continuously weighed on conveyor belts and all fed in proper proportions to the furnace. This is called a "stock feed system" and may be controlled by a punch card or computer system.

A very important application for conveyor scales is "load-out" control where a bulk carrier is loaded by a conveyor equipped with a conveyor scale. The "load-out" system is set for a predetermined load in "tons" (or equivalent weight designation). The conveyor and/or associated feeder, is actuated and loading continues until the exact amount of material is weighed out into a truck, rail-car, barge, or ship. The principal advantages of this type of a load-out system are:

The exact tonnage desired in each truck or carload is easily "dialed in" and accurately controlled—*no overloads.*

No truck or platform scale weighing is required, therefore, hauling cycle time is significantly reduced.

No scale house operator required.

Accurate tonnage figures available in printed form for each load.

Accurate tonnage total of daily production.

Accurate total of number of daily loads.

Many State governmental agencies have adopted this system after reviewing its performance on a variety of applications.

There are two general methods of weighing a bulk material—gravimetric and nongravimetric. By far the most common of the two methods is the gravimetric method for weight determination. If a body is to be weighed, then the gravimetric force must be countered by

an opposing force. By measuring the opposing or counterbalancing force, the actual weight can be determined.

There are three principal categories of gravimetric weighing devices: (1) gravimetric counterbalance systems employing a mass to counterbalance the load; (2) deflectional counterbalancing systems, where the load force causes an elastic element such as a spring to deflect a condition of equilibrium and where the internal forces resist the applied load-force. Deflectional electrical devices fall into this category including load cells; (3) force-balance counterbalance systems in which pneumatic or hydraulic pressure becomes the counterbalance force.

One common method of gravimetric weight measurement is the deflectional counterbalance approach utilizing an electrical transducer such as a strain gage consisting of one or more resistance wires that are supported in a framework or are bonded to a tension or compression member. As the wires are stressed, the resistance—and thus the current—changes in proportion to the load. Strain gage load cells have no moving parts and typically have a deflection of less than 0.01 inch at maximum deflection. Most strain gage load cells of this type are temperature compensated. Another type of load cell is the type using a deflection member actuating a linear differential transformer. This type has the advantage of being able to support a large amount of overload and, in one case, is temperature *controlled* rather than temperature compensated. The load range of this unit is readily changed by altering the size of the deflection member.

Pneumatic and hydraulic load cells are used to directly support the load, or they may be used in a counterbalance system using levers with the air or hydraulic pressure being used to position a scale beam to a rebalanced condition.

Another approach is the flexure plate system which eliminates the knife edge pivots and bearings. Strips of steel in tension suspend the levers from the main frame. The levers, in turn, suspend the weighing platform, in tension by means of identical flexure plates. Very little movement of the plates occurs in the weighing operation.

The principal nongravimetric weigher is the nuclear-radiation gage. This device is relatively new to industry. In this system, a source of nuclear energy is absorbed to a greater or lesser degree by the material in the radiation path. With gamma radiation, the absorption of energy is proportional to the mass of the absorbing material. A nuclear gage is sometimes calibrated by checking against a gravimetric weighing device. The radiation element or source is contained in a suitable holder designed so the radiation is directed toward the material being measured. The radiation detector is placed on the opposite side of the material. The output of the gage thus becomes a measure of material mass.

A belt scale, suitable for in-transit weighing, is comprised of several basic components. The first objective is to measure the load of material on the conveyor belt. This is normally accomplished by a weigh-frame or scale carriage. This typically is a metal framework which supports one or more carrying idlers and transmits the change in weight or displacement of the frame to a weight transducer (a device for translating mechanical displacement to an electrical or pneumatic signal) or merely transfers the displacement through a series of mechanical levers to the final element.

Since any load transducer is only measuring pounds per foot, this signal, in order to be meaningful, must be compensated by a belt speed signal. Therefore, there must be a belt speed compensating device which transmits a linear electrical signal. The speed sensors can either be mechanical or electrical. The mechanical speed detection is typically accomplished by means of a friction driven pulley, in contact with the conveyor belt, which results in the pulley being driven at a speed proportional to the belt speed.

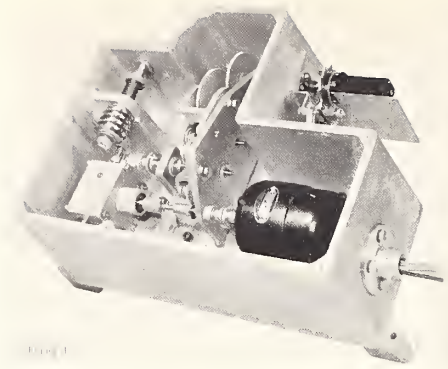
Electrical speed sensors are of four basic types. The tachometer geneator is probably the most popular means of speed detection. The tach (as it is popularly called) generates an output voltage directly proportional to belt speed. The output may either be dc or ac. The ac type is more commonly referred to as an alternator. The third type is a Selsyn motor which produces a three-wire synchro signal with a rotating field proportional to belt speed. The fourth type is a pulse motor which has a number of poles and transmits pulses directly proportional to belt speed.

In many cases, the conveyor belt speed is constant and it is only necessary to couple a time measurement in the integrator to accomplish weight-flow integration.

This brings us to the last of the principal scale elements, the integrator. There are many types commercially available, each with its own distinctive features.

One of the oldest types of integrators is the mechanical wheel or the disk type (fig. 1). A similar system is sometimes used with the pneumatic actuated load cell. The disk is positioned radially on the wheel relative to the conveyed weight. The wheel rotates proportional to belt speed. Another similar type uses an integrator belt which is run at a speed proportional to the belt speed. A wheel carrying a series of small disks rides on the belt causing the wheel to turn. The instantaneous load affects the angle between the wheel and direction of the belt. The two variables are mechanically integraded.

There are many types of electronic integrators. Some are mechanically actuated, others are electrically actuated, some are intermittent, others continuous, some use vacuum tubes, others are solid state.



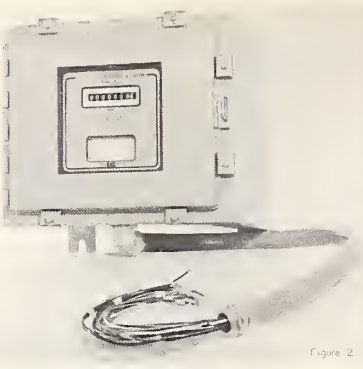


Figure 2

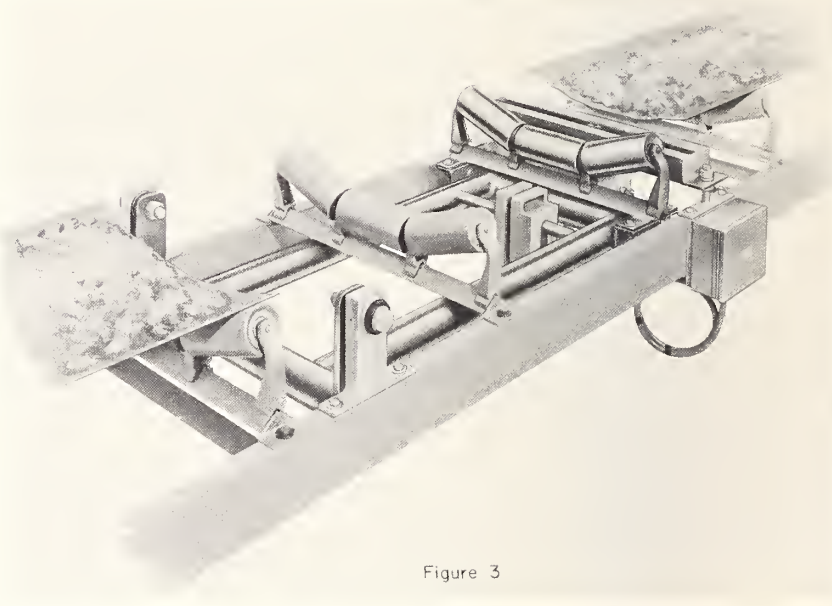


Figure 3

However, the most important characteristic of any integrator should be its capability to integrate both in a negative and a positive direction. This requirement is dictated on a conveyor belt of any length that has worn or new sections of belting and whose weight must be averaged so that when a belt makes a complete revolution, the totalizer ends up with the same reading as when it started. In order to accomplish this, the totalizer must be able to reverse as well as go forward. Most of the electronic integrators accept a variable voltage output signal from the weight transducer. This signal is compensated by the speed generator signal and the resulting voltage is fed to an integrating amplifier. The interating amplifier feeds into a pulsing motor which is directly connected to a counter. The polarity of the amplifier out-

put determines whether the counter motor is driven in a forward or reverse direction. The rate of pulsing is determined by the weight-flow rate. Thus, each output pulse corresponds to a given quantity of material (fig. 2).

Other elements of a scale system may be classified as accessory items since they are not actually required to make the primary measurement, but are only required to supply other supplementary information or operating features.

One of the most popular acessory items appears to be the analog recorder, either circular or strip chart. This type of instrument is used to record rate of flow, acepting a signal direct from the weight-transducer or from the integrator.

A newer type of recording, and rapidly becoming one of the more popular types, is the digital recorder similar to the adding machine tape type. One digital recorder not only prints the total weight but also the date, time, and a product code letter. There are also more elaborate forms of digital recording, including the automatic wide carriage typewriter, which is capable of printing several columns of information from an infinite number of sources.

One of the most important scale applications today is the control of the flow of bulk materials. The conveyor scale or weighing feeder actually closes the control loop. The controller receives the weight signal from the load transducer and provides an output control signal to control the rate of flow of the bulk material. Thus, with the conveyor scale, we have a true closed loop control system.

There are many ways to approach the control of bulk materials through intransit weighing. There are many different types of models and manufacturers of control instruments on the market. Control can be accomplished electrically, pneumatically, or hydraulically, or even through a combination of the three. The weight-transducers transmit an electrical signal which is acceptable to most of the potentiometric instruments available commercially today. The controllers, themselves, may be of the recording, indicating, or non-indicating type, depending upon the requirements of the application. Similarly, the final controlled element, that part of the loop which actually regulates the feed, varies considerably on each application. One of the more popular types of control is to use a variable speed drive on the weighing feeder and regulate the flow of material by varying the speed of the feeder. Another approach is to use a constant-speed weighing conveyor and vary the feed rate of the weighing conveyor by an independent feeder. The type of device selected is usually determined by the type of material being fed.

A vibrating feeder or pan feeder is often selected for coarse material, whereas fine materials are commercially fed with a star or rotary valve feeder, also equipped with variable speed drive.

In another approach, the conveyor belt is loaded directly from a bin and a striker gate, operated by a pneumatic or hydraulic actuator, is utilized to control the flow of material on the conveyor belt. Another means of control is by the load-out control method (previously described) in which a counter is set for a prescribed number of tons and material is fed over the weighing conveyor until the integrator count matches that of the set point counter. This type of control is usually used for loading bulk carriers.

The subject of automatic feed control could be a complete discussion in itself, but time is limited and we have just discussed the more popular forms of controls, without going into a detailed description.

At this time, we should briefly mention some of the different types of conveyor scales as manufactured by the various scale companies. A brief mention of the more distinctive principles of operation of the individual units is all that time permits.

The Merrick Scale Company manufactures three basic types of conveyor scales: (1) Mechanical, (2) Electric or strain gage, (3) Hydraulic. The mechanical scale has been manufactured for the longest period of time. The scale employs a weigh frame and a lever system which transmits the signal to a mechanical integrator. The mechanical integrator works on a wheel and disk principle. The scale has a rate transducer available to translate belt speed into the integrator integration is continuous.

The Merrick Hydraulic Scale receives its signals from the weighbridge through a mechanical level system to a fixed hydraulic load cell. Electrical signals are obtained by connecting through a pressure-to-current transducer and then to a continuous solid state integrator. The hydraulic load cell is a piston-cylinder type cell. The design of the strain gage scale is similar to the hydraulic except that a strain gage load cell is used instead of a hydraulic cell and the output is therefore electrical. Speed compensation is obtained by the use of a tachometer generator.

The Thayer Scale Division of Cutler Hammer utilizes a scale leverage system of vertical steel flexure plates. The plates are held in tension to transmit forces vertically from the weigh idlers through a full leverage ratio to the sensing element. Since the plates are securely bolted in place, the leverage ratios are precisely defined. The multiple level system mechanically amplifies low platform deflection. Tests weights can be placed on the scale platform surface giving a summation of all gravitational forces. Multple ilders are available for longer weigh spans. The load cell is temperature compensated and can withstand 1000 percent overload. Thayer uses a mechanical integrator with a six (6) digit accumulator. They also can offer a solid state integrator with a digital belt speed compensating signal. The amplifier is solid state with plug-in circuit boards.

The Trans-Weigh Company's belt scale utilizes two or more idlers transmitting a load-force to a single strain gage load cell.

The ABC McDowell scale is a weighbridge supporting multiple idlers, with a compression type of strain gage load cell. The cell is temperature compensated and hermetically sealed.

The B.I.F. Division of New York Air Brake Company manufactures a converyor scale called Conveyoflow using a pneumatic load cell. The manufacturer states the pneumatic load cell is not temperature sensitive. The pneumatic load cell operates on a force-balance system and has an instantaneous recurrable deflection. This deflection is in the order of .003″ to .005″. A pneumatic load cell can be used in an explosive atmosphere. The Conveyoflow utilizes a wheel and disk integrator. The integrator can subtract using a forward-reverse counter. The manufacturer claims that the load cells cannot be damaged when overloaded since they "bottom-out." The load cell requires a good clean dry air supply.

Fairbanks-Morse uses a mechanical scale system using a spring loaded scale beam to counterbalance the load force transmitted by the mechanical lever system. The belt speed is transmitted to the integrating mechanism by a sprocket chain from a friction roller in contact with the belt. This scale utilizes a code and disk mechanical type of integrator. They also have a new strain gage load cell scale.

Another type of electrical-type scale is manufactured by Gilmore Industries, Inc. The scale carriage consists of two or more idlers. The electrical motion transducer is a strain gage, which is temperature compensated and is hermetically sealed. The integrator is electronic, solid state, with a motor driving the totalizing counter through a belt. The counter is the reversing type for calibrating the empty belt.

Ramsey Engineering Company manufactures a conveyor scale which is unique in its principle of operation (fig. 3). Ramsey uses a weight transducer which consists of a deflecting bar actuating an LVDT. The maximum movement from zero to full load is 0.015″. The transducer, because of its design, can be loaded up to 1000 percent overload. In addition, the transducer housing is temperature controlled rather than temperature compensated. The Ramsey scale carriage, constructed of tubular welded steel, is supported by rubber trunnions type pivots. The integrator is electronic and solid state incorporating a forward-reverse counter for averaging out the heavy and light section of the conveyor belt. The integrator is housed in a NEMA 4 enclosure, which is resistant to dust and moisture conditions. It also has the capability of transmitting a current signal proportional to tons per hour to a remote located instrument.

The weighing device which we will mention is the radiation type as manufactured by the Ohmart Corporation. The main advantage of the nuclear scale is there are no moving parts, permitting the primary sensor to operate in corrosive and dusty atmospheres. The

sensor does not come in contact with the belt and the manufacturer states the scale is then not affected by belt tension and misalined idlers. Also only eight inches of belt are required for a measurement. The manufacturer states there is a built-in calibration checker. Also the unit can be used on all types of conveyors. The scale actually measures mass weight per unit area. Calibration is often achieved by using batch scales for check points. The integrator is an integral part of the recorder or can be located remotely from the recorder, receiving a signal from the recorder.

The Toledo Scale Corporation manufactures a strain gage load cell conveyor scale. They too use a single weigh idler for simplicity of installation and to eliminate all other effects except the load on the belt. They utilize the principle of four parallelograms using flexure stabilizers, which are designed so only the true axial load on the belt is transmitted to the load cell. The output of the load cell is channelled into a high-speed servo unit. The servo system, in addition to being a load indicator, positions the input of a ball-and-disk mechanical integrator. The Toledo system has the capability of measuring negative loads, compensating for light belt sections. The manufacturer claims this feature eliminates the problem of excessive wear on the integrator. The belt speed compensating unit is on the bottom side of the belt near the scale. The roller can either drive the disk in the integrator directly through a flexible shaft and suitable gearing, or it can drive a Selsyn generator which drives a Selsyn motor in the unit to drive the integrator disk through gearing. The output shaft of the integrator drives a standard mechanical counter through suitable gearing to read the total weight. The integrator and gear trains are enclosed in a dust tight enclosure.

We realize that there are other manufacturers of conveyor scales, but due to time limitations, we tried to mention those which have distinctive features. Many of those not mentioned are very similar in operating principle to those mentioned in this paper.

We cannot leave the subject of conveyor scales without briefly discussing gravimetric feeders, which are weighing devices of another type. When we discuss feeders, we are talking about control and here is where instrumentation and closed-loop circuits enter into the weighing picture. It is very easy to run into "application of scales" at this point and this subject is covered in the second paper by Mr. McEntee. We would like to offer a few brief comments on design characteristics of weighing feeders.

There are several different approaches to controlling the feed rates of raw materials using weighing feeders. One of the more popular types of feed control is the use of a striker gate which is raised or lowered to control the amount of material on a weighing conveyor. The striker gate can be actuated by an electric, pneumatic, or hy-

draulic actuator with the position of the gate being determined by the conveyor scale signal as compared to the desired control point.

Another type of weighing feeder is one where the striker gate is kept in a fixed position and the speed of the weighing feeder belt is varied. This is accomplished by the controller actuating a variable speed drive.

On a third type of approach, the entire weighing feeder section is weighed. The conveyor is usually constructed of a light material so as to reduce the tare weight. The feed to the belt is controlled by a variable speed drive operating a star valve or a screw feeder.

On another type of feeder the weight of the material on the weigh feeder pivots the feeder and the change in position of the feeder changes the amount of feed through an interconnecting pickup, either electrical or through an electric-mechanical servo system. There are also feeders manufactured by a few companies which have a direct mechanical linkage to effect a change in the feed rate.

There are many other methods of controlling feed rates of bulk materials, but we only have a limited amount of time and we have, therefore, had to limit the amount of detail which we could present today.

(B) APPLICATIONS

by R. J. McEntee, *Sales Manager, ABC Scale Division, McDowell-Wellman Engineering Company, Cleveland, Ohio*

Introduction.

The proper application of a continuous scale system involves not only the selection of the right design of scale, but, equally important, an analysis of the product, the material handling considerations of the transporting system, and the instrumentation required to provide totalized results and/or a record of operation.

This paper will mention product characteristics, material handling problems, and various instrument schemes currently enjoying wide use; actual applications will be discussed for several industries where continuous weighing systems are popular.

Investigation.

All manufacturers use a "Data Sheet" to initially define customer requirements. Obvious information asked for includes:

Material
Rate of Flow
Density

Conveyor Belt Speed
Conveyor Inclination
Conveyor Width
Type of Idlers
Idler Spacing

Additional questions are necessary to provide a thorough study of a problem:

Temperature Extremes
Particle Size or Sieve Analysis
Percent Moisture and Desirability of Moisture Compensation
Desired Accuracy
Storage Hopper Configuration
Type of Readout Instruments
Alarm Signals

Although not all-inclusive, the above listings illustrate the parameters that affect the application of continuous scales.

Product Groups.

Literally dozens of charts have been published by manufacturers dealing with bulk materials which categorize hundreds of products by their physical properties. The goal of these charts is to help select equipment capable of coping with the unique flow characteristics of each. The significance of flow characteristic data is appreciated when it is realized that continuous scale applications often involve not only conveyor belt scales, but also, scale feeders. Here, the scale is an integral part of the conveying mechanism and the entire unit is located below the storage hopper. The application engineer who promises to weigh the material passing over the scale, but assumes no responsibility for getting the material to the scale is not solving the problem. And, with continuous scale systems, getting the material to the scale without interruption is often the more difficult task.

Material Handling.

As it affects the scale manufacturer, the material handling problem is primarily one of assisting the engineer with hopper design and selecting the proper feed control device at the scale inlet.

Until recently very little scientific data had been available governing the correct bin design for bulk materials. Experience, gained through trial and error, had taught broad principles such as, a conical bin will pass material better than a flat walled bin, and then, one vertical side to a conical bin is better than a spherically shaped conical bin. The difficulties in not having reliable data became more pronounced in recent years with the introduction of so many new bulk materials—especially in the chemical industry.

Instruments are available today which measure compactness, angle of respose, shear forces, angle of friction between the bulk solid and the bin wall material, and formulas have been developed which give bin discharge opening and shape, angle of side slopes and other parameters to aid material flow.

The proper feed control device at the scale feeder inlet is equally important to a sound weighing system. Manufacturers choose between a shear gate, rotary valve, vibratory feeder, or screw feeder (fig. 1). Occasionally, combinations of these are used such as, vibrating-screw feeder. Each has merits; the gate, offering lowest cost but useable only on free-flowing, small-particle material; the rotary valve, suitable for floodable materials but discharging in increments rather than continuously; the vibratory feeder, ideal for lumps and relatively large particle sizes; the screw-feeder, excellent for both floodable and nonfree-flowing materials of small particle size.

Instrumentation.

Continuous belt scales and scale feeders are available using mechanical, hydraulic, pneumatic, and electronic weight sensing mechanisms. The mechanical and electronic units are most popular, and, since both produce electronic outputs, the instrumentation systems in the continuous scale market are primarily electronic (fig. 2).

Both analog and digital control techniques are applied. Digital instruments are relatively new and are just beginning to gain wide acceptance in most industries, although the petro-chemical industry has used digital control instruments for approximately 5 years. The weighing industry is almost certain to increase its use of digital controls in the future; however, at present, the overwhelming majority of controls are analog.

Most scale manufacturers produce their own integrator; that is, an electronic panel mounted instrument which receives and amplifies a rate of flow signal from the scale, computes the rate with respect to time, and drives a motor to which is connected a gear train and totalizing counter, thereby displaying an accumulated total. Beyond this, it is common practice to rely on established instrument suppliers for such items as chart recorders, ticket printers, and computing elements. The scale manufacturer does, however, design control systems and assumes responsibility for all instrumentation applied.

An example of instrumentation in its simplest form is a mechanical conveyor belt scale which mechanically multiplies belt speed by belt load and drives a 6-digit totalizing counter located in the scale cabinet. Additional examples of instrumentation are discussed in the following section.

Industrial Applications.

Sand and Gravel—Load-Out Control System.

A continuous weight of both fine and coarse aggregate is obtained from screens. Scale output is integrated, and a permanent record of input to storage bins is achieved with a chart recorder. Load-out into trucks or rail cars is eccomplished on a preset batch-weight basis with scale output integrated and printed on a multicopy billing form. In installations of this type, it is possible to eliminate truck scales or track scales.

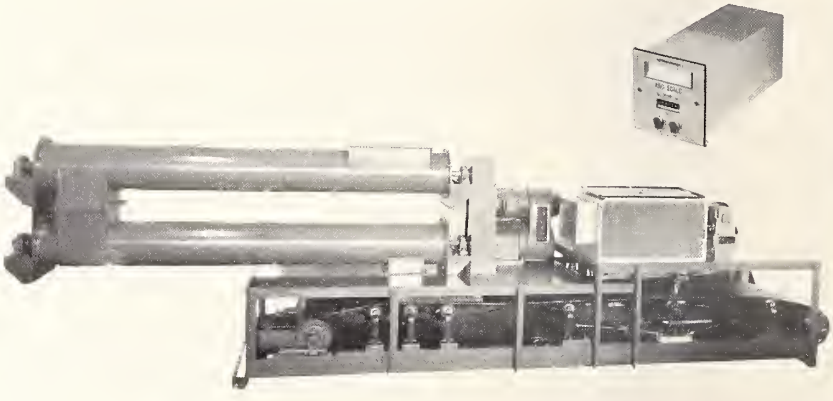


FIGURE 1. *Scale Feeder and Double-Stack Screw Pre-Feeder*

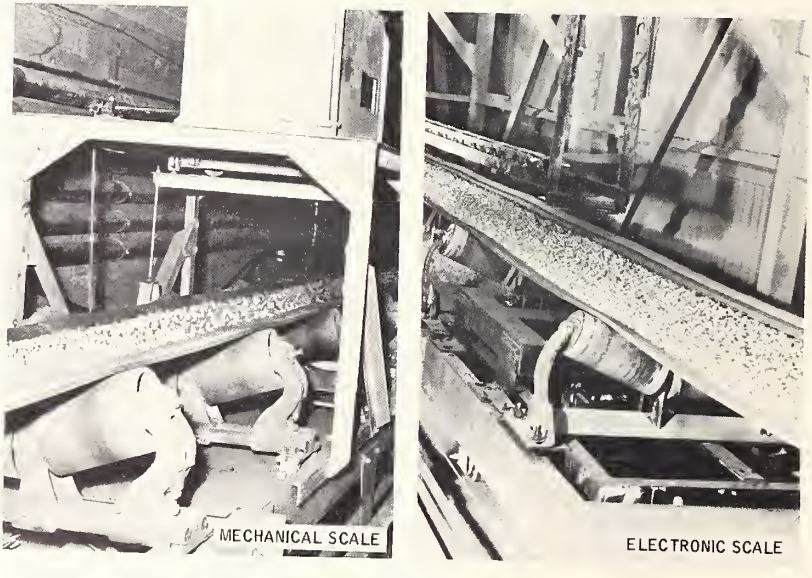


FIGURE 2. *Most Popular Type Belt Scales are the Mechanical and Electronic Units*

Pulp and Paper Industry—Automatic Moisture Compensation Control of Wood Chips to Digester.

Continuous belt scales have long been used to control wood chip flow to the digester where the chips are cooked in an acid bath in preparation for the paper machine. In the past, it has not been possible to control chips based on dry weight since an accurate means of moisture measurement was not available. (The difficulty has been in distinguishing between the free hydrogen—which appears as moisture and is what a moisture gage actually measures—and the natural hydrogen in the wood). With the problem just about solved, it is expected that this application will become a frequent one for scale companies.

Both a total weight (wood chips plus water) signal from the scale and a water-only signal from the moisture gage are directed to a computing relay which simply subtracts water from the total and transmits a "dry wood chip" signal to the set-point controller where a comparison is made with set point. A corrective signal is then transmitted to the vibratory feeder via the control rectifier to modulate flow. Both total weight and dry wood chip weight may be totalized for record purposes.

Coal Industry—Unit Train Loading.

A common application is the loading of coal from stockpile to unit trains. A somewhat different approach is often taken to the standard practice of a conveyor belt scale. Because tonnages are relatively high (1,000 tons per hour and up), even a low cost commodity like coal can cost the shipper considerable sums of money in lost revenue unless weighing accuracy is high. The conveyor belt scale is adversely affected by the unusually long conveyors (commonly, 2,000 to 4,000 feet), and conveyors with one or more vertical curves.

Consequently, a "coal-loader" is employed. This is a scale (usually mechanical) mounted on a special conveyor built by the scale manufacturer, and designed to closely control belt tension and vibration. A typical unit is 25 feet long, uses multiple weigh idlers, has gravity take-ups, is completely enclosed, contains built-in calibration equipment and is always calibrated to an acceptance tolerance of better than ± 0.25 percent of actual weight based on track scale calibration. The coal-loader is used as the basis for payment and is inspected by the local Weighing and Inspection Bureau under the jurisdiction of the Association of American Railroads.

Coal is free flowing and of uniform size, unless frozen, and thus a manual shear gate suffices at the conveyor inlet. Instrumentation requirements include a remote rate of flow meter with alarm contacts, a remote totalizer, and a tape or ticket-type printer for bookkeeping purposes.

Cement Industry—Raw Mill Proportioning.

The manufacturers of Portland Cement have been progressive in recent years in their attempts to reduce operating costs. Virtually all new plants today are computer monitored or computer controlled and digital systems are gaining in popularity. Both conveyor scales and scale feeders are widely used in proportioning of raw materials to the kiln.

A typical raw mill proportioning system allows the chemist to adjust percentages of each material without regard for total feed rate and, similarly, permits total feed adjustment independent of the proportions.

In the system illustrated, the belt speeds of all weigh feeders are modulated in unison from the master variable frequency drive which is paced by the raw mill sound level. The belt loadings are controlled only by the percentage settings as determined by the chemist (or the computer).

Nuclear Scales.

Applications of belt scales have broadened in the last 4 years with the introduction of a non-contact scale that can be used on many types of conveyors—belt, vibrating, apron, and air slide. The scale employs nuclear radiation to measure belt loading with belt speed correction available for nonuniform speed conveyors.

The scale is of prime interest where vibration or variable belt tensions would adversely affect conventional scales and where short term accuracy is not of paramount importance.

Rail-to-Water Load-Out.

Common to many industries and of increasing importance to weights and measures officials is the rail-to-water weighing application wherein the continuous scale is used as the basis for payment. Hopefully, the day is nearing when uniform codes will be available to help the bipartisan official decide what constitutes satisfactory accuracy and what standard to use in evaluating results.

Reference:

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(C) TESTING

by P. W. Chase, *Project Engineer, Minnesota Ore Operations, U.S. Steel Corporation, Pilotac Plant, Mountain Iron, Minnesota*

Comments on conveyor scale weighing performance by plant operators seem to fall into two categories, with very little middle ground. One group is of the opinion that if conveyor scales can be trusted at all, it is only to within about 10 percent. The other group claims consistent accuracies of 1 percent, or ½ percent, or even a few tenths of a percent. In this writer's experience, further questioning on the above comments generally yields indication of an inverse correlation between percent error and maintenance.

This maintenance comprises mainly calibration and testing procedures. These, in turn, comprise mainly procedures designed to ascertain and control the relationship of the conveyor belt, and especially its load, to the weighing mechanism. A relatively small percent of maintenance is concerned directly with the weighing and totalizing per se.

To establish a common basis around which to discuss calibration and testing, certain assumptions will be made about the installation. Possible relaxation of these constraints will be mentioned later and discussion by the panel is entertained. The assumptions are as follows:

1. The conveyor belt is free of vertical curvature, or at least the weighing area is distant from such curvature.
2. The scale is located at a point of low and preferably uniform conveyor belt tension. (This implies a gravity takeup and a horizontal conveyor. If an inclined conveyor is used, the scale should be as near the lower end as possible.)
3. All sensing idlers and at least two adjacent idlers on each side are selected for concentricity.
4. Conveyor belt speed is accurately measured.
5. Idler alinement is within 0 to + 1/32 inch [1, 2].
6. The conveyor supporting structure is rigid.
7. A shallow troughing angle is used on the conveyor belt.
8. The weighing area is free of skirt boards.
9. The weighing area is sheltered from wind.
10. The no-load to full-load deflection is very small [3].
11. The belt is relatively uniformly loaded and at about 75 percent of rated scale capacity.
12. The weighing area is kept clean from spillage and other foreign matter.

13. The integrator or totalizer can accumulate in either plus or minus direction.

This is admittedly an idealistic list, and it is certainly a rare weighing application which fulfills all the requirements. The statements do permit discussion of testing and calibration apart from these common perturbations:

Calibration techniques fall into three general categories, namely: material runs, chain weighing, and static weighing.

Common to any of these techniques is the requirement of careful zeroing. Perhaps an additional requirement for completely uniform conveyor belting should have been added to the list above. Instead, the plus and minus total accumulation is used to permit zeroing despite the fact that different sections of the conveyor exert slightly different forces on the weighing idlers even with an empty belt. For this reason, it is essential that the zero testing include several complete passes of the conveyor belt. The totalizer should accumulate zero tons after any unit number of passes.

Material-run offers the greatest assurance of accurate calibration because it is a direct test of the entire system, measuring totalized weight in an operating environment. Material passing over the scale at or near the normal loading is collected and static weighed to provide an accurate known standard. It is also possible to check the calibration at other points above and below the normal loading to establish a calibration curve. Because conveyor scale installations in the real world often fall short of the requirements listed earlier, it is useful to consider which problems are partially compensated for by this testing method. Tension effects due to loading of an inclined belt are included in the test, as are some effects of a vertical curvature if it is not in the weighing area. Small misalinement effects and effects of load sensing mechanism deflection (both are related to tension) are also included in the test.

Probably most scales which have been approved for billing purposes are calibrated using material-run.

Although the material-run test is certainly direct and desirable, in many scale installations it is very difficult to accomplish. These installations must rely on chain weigh testing as the most accurate available calibration.

The roller-type chains used in this testing are accurately weighed at periodic intervals and the known weight per foot is then used as the standard for calibration. It is important that these test chains be kept clean and in good condition to retain their value as a standard. They should be kept dry and under a dust-cover when not in use.

As in the zeroing test, the test with the chain should include several unit passes of the conveyor belt. Assuming that the total length of the conveyor has been accurately measured and all of the constraints are applied, this technique should be capable of calibration to within

about ±½ percent [1]. Note that the chain weight procedure does not include the tension effects produced by a loaded belt. On an inclined belt, particular attention must be paid to idler alinement and small deflection under load because both errors are increased by increase of belt tension.

The least direct calibration technique, and one which in this writer's opinion should be confined to interim testing, is that of static weighing. In this method, a known weight is added to the scale suspension and a unit number of conveyor passes is used to establish the calibration in similar fashion to the chain weigh technique. In addition to the severe list of constraints previously mentioned, this method has several additional problems:

1. If the conveyor load is not transmitted to the weight sensor at a one-to-one ratio, it is necessary to accurately establish the true ratio.
2. The length of the weighing section must be accurately measured.
3. The effects of even the nominal belt tension of the no-load condition and the effects of conveyor belt stiffness are not included in the test.

Despite the problems above, this test is useful as an easily performed interim check. Failure of the check to fall within predetermined limits would indicate need for recalibration by material-run or chain weigh tests.

The relatively new nuclear scale offers some promise in noncontract weighing not subject to errors from belt tension or small misalinements. This device will undoubtedly see wider application in the future.

Considering the relative accuracy and inconvenience of the three techniques discussed, a program of the following type should be considered for testing a conveyor scale:

1. Frequent, preferably daily, zero checking.
2. Frequent, preferably daily, testing by static weight.
3. Periodic chain-weigh calibration.
4. Initial calibration by material-run testing with periodic retesting dependent on the veracity of the chain-weigh calibration.

The optimal periods between the chain-weight and material-run tests are dependent on the individual installation, largely influenced by how well the installation meets the frequently mentioned list of constraints.

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[3] Colijn, op. cit., recommends .005 in total deflection. Small and Colijn, op. cit., recommends 1/64-inch total deflection.

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WEDNESDAY AFTERNOON, JULY 13, 1966

No Business Session.

MORNING SESSION—THURSDAY, JULY 14, 1966

(J. L. Littlefield, *Vice Chairman*, Presiding)

THE DEVELOPMENT OF API STANDARDS 1101 AND 2531

by L. J. Barbe, Jr., *Supervising Engineer, Oil and Meter Measurement, Humble Pipeline Company, Houston, Texas*

Abstract.

The paper describes the organizational origins of Standard 1101 in ASME (American Society of Mechanical Engineers) and API (American Petroleum Institute). Basic metering guides contained in the standards are described. Of special interest are reasons for omitting metering tolerances from the standard. Precautions for metering and calibration of provers are enumerated. Recent developments in meter proving equipment are described.

Origins of Standard 1101.

API Standard 1101 had its beginning from activities of the ASME, which had organized its Research Committee on Fluid Meters in 1916. The committee had as one of its objectives "the preparation of a textbook on theory and use of fluid meters sufficient as a standard reference." The initial report assembled by this committtee, published in 1924, has been supplemented and revised many times. A very knowledgeable and authoritative text titled, "Fluid Meters—Their Theory and Application," was the final result. The information in the text is not limited to petroleum fluids, but covers numerous types of liquid and gas fluid meters.

Prior to 1941, the ASME Research Committee on Fluid Meters had sponsored significant research on positive displacement meters at the University of Oklahoma. The API became interested in the project and a joint committee, the ASME–API Committee for Volumeter Research was formed to continue the program. The research was completed and the results published in the May 1943 transactions of the ASME.

The P.D. (Positive Displacement) meter research work demonstrated that such meters can accurately measure liquid hydrocarbons. The oil industry, recognizing the need for an authoritative guide for their use of such meters, called upon the ASME–API joint committee to prepare a tentative code. Methods already prescribed by other bodies, including the National Conference on Weights and Measures,

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were reviewed and recommendations of meter manufacturers and users were obtained.

The ASME–API Petrolium P.D. Meter Code No. 1101 (Tentative) was drafted by the joint committee and published in 1946. The code was revised in 1952. Subsequently, ASME withdrew from joint sponsorship, because the primary research was accomplished and Code 1101 had become almost exclusively a petroleum industry activity.

The current codification is embodied in API Standard 1101 (1960), and is titled "Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meter." The responsible API body is the "Committee on Liquid Metering." It is significant to note that Positive Displacement has been dropped from the sponsoring committee's name in recognition of other types of petroleum meters which are coming into use.

Contents of Standard 1101.

The contents of Standard 1101 are broken down into these major sections:

Section I—Installation
Section II—Meter Provers and Their Calibration
Section III—Meter Proving Procedures
Section IV—Meter Performance (effects of temperature, pressure, and flow rate)
Section V—Operation and Maintenance of Metering Systems
Appendix—Installation Diagrams, Truck and Loading Rack Meter Facilities, Test Measure and Prover Tank Construction, Sample Forms, Tables, etc.

Application of Standard 1101 to Metering.

The measurement performance required of a metering facility will vary with different branches of industry and among individual operators. The accuracy or tolerance required is governed by the nature of the operation, the degree of precision obtainable in the particular type of operation, and by practical economics.

Standard 1101 recognizes that differences in tolerance requirements for metering will unavoidably exist. For this reason numerical limits are purposely omitted from Standard 1101 where possible. The Standard concentrates on techniques and procedures. Where desirable or neecssary, metering tolerances are left to the discretion and mutual agreement of the parties concerned. Where contractual exchanges are involved, the metering tolerances are generally specified in the contract.

Examination of some typical situations will illustrate why different operators may require different metering tolerances. For example,

truck meters and loading rack meters are operated intermittently to measure comparatively small batch quantities. Operating conditions for these meters inherently include frequent starting and stopping of the meter, periods of time during which the meter and contents are idle, variations in metering pressure, and variations in metering temperature. These are less than optimum conditions if one is to obtain the very highest order of measurement precision. In retail dispensing of petroleum liquids, the volume measured for an individual transaction is usually so small as to make adjustment of the quantity to 60° F. base neither necessary nor practical.

On the other hand, a pipeline transportation meter will handle relatively large volumes under comparatively stable conditions of temperature and pressure. Incentive exists for maintaining close-accuracy tolerances, because a small error multiplied by a large volume becomes significant. Reduction to 60° F. reference base is usually mandatory.

Let us assume a theoretical facility measuring 100,000 barrels (4,200,000 gallons) per day of liquid valued at $5.00 per barrel. Let us also assume that to improve the measurement by 1/10th of 1 percent would require some special equipment and several hours additional labor for taking data and making calculations. Inasmuch as the value of the liquid represented by 1/10th of 1 percent is $500.00 per day, it is quite possible that the additional costs can be justified. On the other hand let us assume that an 8,000 gallon transport is being loaded with gasoline valued at about 26 cents per gallon and that by the use of some additional equipment and by special calculations the measurement tolerance can be improved 1/10th of 1 percent. In this case the additional 1/10th of 1 percent represents a value of only $2.08. Obviously this is not sufficient to justify the cost of the additional labor, especially when we consider this is a plus or minus value.

Thus Standard 1101 leaves the establishing of metering tolerances to the meter users. Or, in cases where the consuming public must be protected, authoritative codes such as NBS Handbook 44 may be invoked to cause the maintenance of adequate meter measurement.

Meter Accessories.

Many things external to a meter can affect its accuracy and mechanical life. All too often the meter is blamed for poor performance when in fact it is impossible for it to perform properly under the conditions of its application. One common fault of operators is application of excessive meter mechanical loading. Use of too many devices mechanically powered by the meter can adversely affect meter performance under variable flow conditions and shorten meter life. These devices include various excessive combinations of large numeral

counters, ticket printers, electric pulsors, set-stop valves, samplers, temperature compensators, gear adjustors, combinators, etc.

A P.D. meter should be considered primarily as a precision instrument for measurement. It is not designed for, nor should it be used, as a prime mover for turning heavy mechanical loads. In the case of retail loading rack and truck meters, a number of these mechanical devices are perhaps necessary. It is recommended that efforts be made by each operator to keep meter torque load to the minimum possible.

Performance of air eliminators and valves can have obvious effects on meter accuracy. Air or vapor not eliminated from the measured stream will register as liquid at liquid prices. Valves affecting meter registration integrity should be capable of positive bubble-tight seal at all the operating pressures encountered. Set-stop valves should close smoothly and not create shock and backlash in the meters.

Effects of Temperature and Pressure.

Where large volumes are measured it sometimes is desirable to adjust the metered volume for temperature and pressure. The procedures for this are described in the Standards. We will note here only an example of some typical values encountered:

Assume: 68°F. API gasoline measured at 50°F. and 25 psi.
If the registered volume is 100,000 gallons at unity meter factor, adjustment to atmospheric pressure would increase the volume 21.25 gallons. Adjustment to 60 °F. would increase the volume another 680.00 (table 6)/700.00 (table 7) gallons. Combined adjustment to net for both temperature and pressure then would be 721.25 gallons or an increase of 0.72 percent.

Design of Meter Provers.

Standard 1101 on meter prover capacity requires that the capacity of a prover shall not be less than the volume delivered in one minute and that preferably, it will be 1½ to 2 times the volume delivered in 1 minute. The reason for this minimum limitation is to minimize the slight errors which may be in gage readings, clingage, run-down, cyclical meter compensators, etc. As will be mentioned later, there are types of provers where these slight errors can be eliminated and the prover volume can be smaller.

Calibration of Meter Provers.

Weights and Measures personnel are often required to perform or witness water-draw calibration of meter provers. The following are some principles which, if observed, will expedite the obtaining of repeating runs, and reduce the amount of uncertainty in the results.

1. Use clean water with a minimum of dissolved air or other gases. Do not let water stand in the tank any longer than necessary before beginning withdrawal. This will lessen the amount of gas bubble formation in the tank.
2. Utilize weather conditions, coverings, or thermal insulation which reduce ambient temperature effects on the prover.
3. Provide an ample size water-draw connection. A two-inch connection with a good quality ball or plug valve will speed up the water-draw and permit easy throttling for topping out test measures.
4. Use care to accurately scribe gage scales, and properly position them as required by the calibrated volume. Attach in a secure and stable manner on the tank and seal in place. Scales on upper and lower neck should be mounted in the same vertical quadrant. The precision of this operation is equally important to that of the water-withdrawal procedure.

API Standard 2531.

At the time of the last revision (1960) of Standard 1101, developments were being made concurrently in refinement of mechanical displacement meter proving techniques. In 1963, the API published Standard 2531, "Mechanical Displacement Meter Provers." These provers to date have found their greatest application outside retail metering circles. However, a number are now in service at truck loading racks and are subject in some instances to approval by State or local sealers.

A detailed listing of the advantages of displacement provers appears in Section V of Standard 2531. The more important advantages are:

1. The meter is proved under operating conditions using running start-stop procedures.
2. Prover volume can be less than required for prover tanks.
3. Adaptable to automated meter proving.

Mechanical displacement provers are built in many configurations. All may be broadly categorized as being either of the bidirectional or unidirectional type. Both types are not in oil industry service in considerable numbers throughout the world.

One such prover is illustrated in figure 1. This drawing is taken from Standard 2531 and is a typical layout of a Bidirectional Prover System. The prover is basically a cylinder from which a piston or sphere displaces a known volume of fluid. It consists of a calibrated length of pipe between two precision detector switches, a sphere or cup-packed free piston displacer, and valving for reversing stream flow to reciprocate the displacer. The meter to be proved is equipped with an electrical pulse generator such that the output pulses, usually

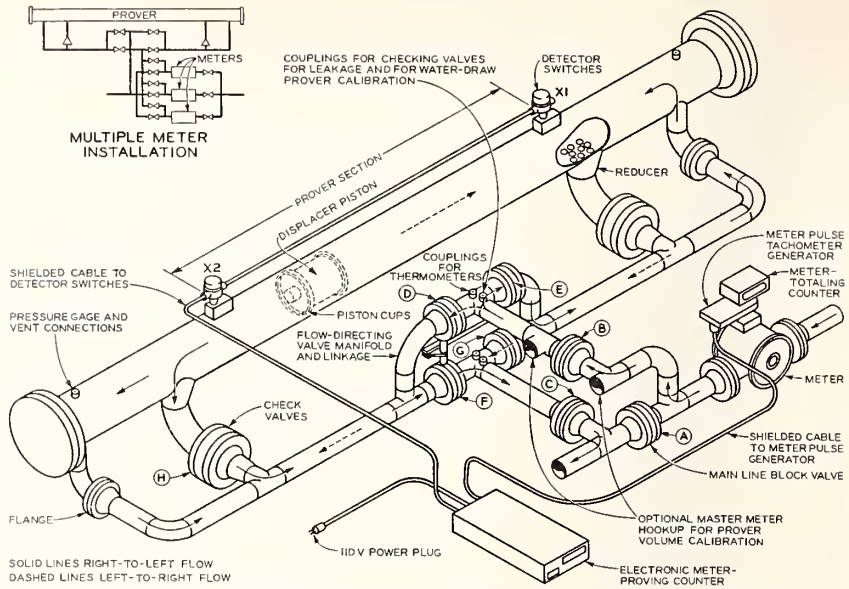


FIGURE 1. Typical Layout of Bidirectional Straight-Type Piston Prover System.

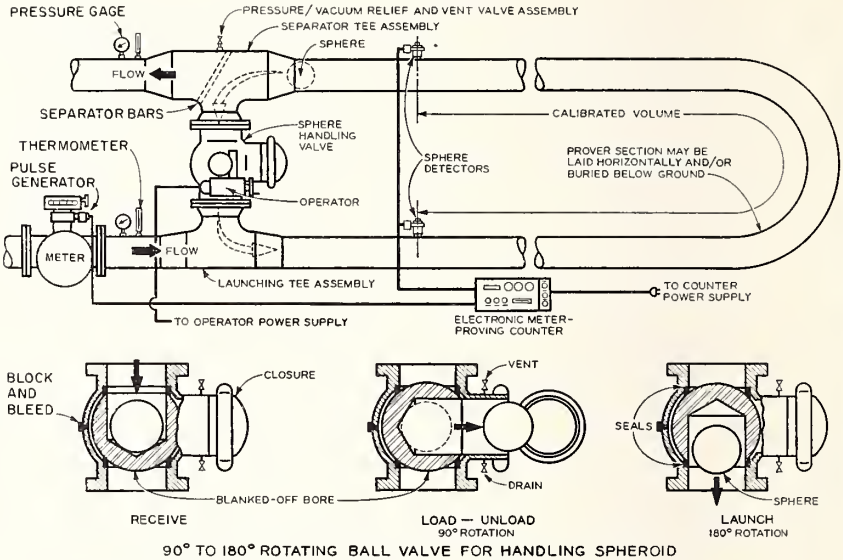


FIGURE 2. Typical Unidirectional Return-Type Prover System.

in the order of 100 pulses per gallon or 1000 pulses per barrel are proportional to the quantity delivered through the meter.

The detector switches "gate" a high speed electronic counter on and off to count the meter pulses generated by the meter while the fluid is

being displaced by the displacer in traveling between the detector switches. Meter factor is determined by comparing the meter registration of the electronic counter with the known calibrated displacement volume between the detector switches. Appropriate adjustments for temperature and pressure are usually made in arriving at the meter factor.

The unidirectional prover uses a spheroid displacer traveling in an "endless loop." The principle of operation is similar to the bidirectional prover, except the spheroid displaces in one direction only. Figure 2 taken from API Standard 2531 pictures a prover of this popular type.

Electronic Master Meter Proving.

High speed electronic pulse counting equipment first adapted for use with displacement provers has in very recent years been adapted for master meter proving. The master meter is first calibrated into a conventional prover tank or by other recognized method. The master meter may then be used to prove an operating meter by use of electronic equipment.

A pulse generator is attached to the master meter. The meter to be proved is fitted with a mechanical or electronic switching device which gates an electronic counter on and off at the end of a prescribed number of meter shaft revolutions or preset volume. The registration of both meters for the preset proving volume is then available. Comparison of the operating meter volume registration to that of the master meter is then made to arrive at a proof of the operating meter.

Future Revisions of Metering Codes.

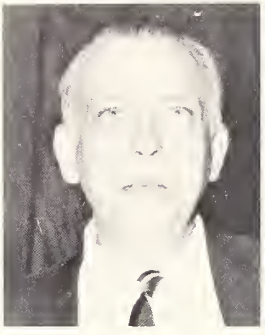
The Committee on Liquid Metering is considering revision or supplementation of Standard 1101 to cover the exceptions and/or requirements for turbine metering and for metering viscous fluids. These additional guides are expected within the next one or two years.

Conclusions.

Standards 1101 and 2531 have made material contribution to obtaining accurate petroleum measurement. The API Committee on Liquid Metering solicits your suggestions for improvement of these Standards. We are particularly grateful to the National Bureau of Standards for furnishing calibration of our master test measures and other petroleum measurement standards.

THE RETAIL GAS PUMP—ACCURACY PROBLEMS

by R. E. Risser, Jr., *President, Southwest Pump Company, Bonham, Texas*



In a discussion of accuracy or the lack of it in retail gasoline dispensing equipment, it is necessary to comment briefly on the ever changing motor fuels to be handled. These fuels contain not only the usual carefully blended hydrocarbons, but also many very sophisticated chemical additives. While the value of such additives to the general public is unquestioned, the unexpected use of new ones can, and often does, pose problems of near catastrophic proportions to the dispenser manufacturer.

To illustrate this point, after testing the equipment, our factory sprays it with a light preservative oil which is normally flushed out in the first twenty-five gallons delivered at installation. However, in the presence of one of the new additives this oil, proven to be so satisfactory in the past, suddenly assumes the consistency of molasses and collects on the piston and valves of our meter thus causing the slow-flow calibration to drop well below the full flow.

In the comments on dispensers and their components that follow, other calibration difficulties resulting from these additives, in addition to those from the better known characteristics of gasoline, will be discussed in some detail.

When a situation like the one with the preservative oil and the additive occurs, it appears that the dispensers were never tested at the factory. Contrary to appearance no gasoline pump manufacturer is so confident of the suppliers, his manufacturing techniques, his parts inspection, or his personnel as to ship without complete and comprehensive testing. This testing follows the same basic pattern for all with such additional individual tests as product characteristics warrant.

An average service station pump installation with means for testing calibration, power input, pressure, suction, or ability to separate air is to be tested as follows:

1. After connecting electrical leads and suction line to dispenser, close all air valves, and open all others including nozzle.
2. Close disconnect switch and start dispenser.
3. When the air in the system has been dissipated with the pumping of a minimum of 25 gallons of naphtha, check input power (525 watts) and delivery rate (14 g.p.m.).

4. Check for leaks after closing nozzle, stopping dispenser, and opening compressed air valve. (Test Pressure: 100 pounds per square inch.)
5. Close compressed air valve, open nozzle and slowly turn dispenser switch until watt-meter indicates initial contact. At this point check to be certain that computer pawl is properly timed to insure interlocking.
6. With nozzle open and dispenser running, close quick closing suction valve for wet vacuum test. (25 feet of Hg.)
7. Open quick closing valve and operate dispenser normally for the 5-gallon calibration tests being certain to stop and reset between each to prove separator check valve. At this time, adjust meter to minus 2 cubic inches (0 with gasoline) allowing only one cubic inch variance at 2 g.p.m.
8. By opening air valve with nozzle open and dispenser running, test separators for a complete stoppage of flow.
9. Every ten units, test air separator efficiency by comparing a full-flow calibration check with air entering suction line through a .030 inch orifice and open orifice valve to the previous one without air and reject any with a variation of more than 3 cubic inches.

An average service station installation with provisions for testing calibration, rate of flow, pressure drop, or valves is to be tested as below:

1. After being certain that compressed air valve is closed, connect electrical leads and supply line.
2. With nozzle open, start pedestal and pump 25 gallons through it to disperse air.
3. Close nozzle, shut off dispenser, and open compressed air valve to check for leaks. (Test Pressure: 100 pounds per square inch.)
4. Close compressed air valve, start dispenser, and check flow rate (13 g.p.m.).
5. Turn off dispenser, reset, and slowly turn on until pilot light indicates switch contact is made. At this spot in the cycle, check computer pawl for proper position to insure interlocking.
6. Operating dispenser normally, adjust meter calibration to minus 2 cubic inches (0 with gasoline) on the full flow 5-gallon tests, and reject any with a variation of more than one cubic inch at 2 g.p.m.
7. Test valves by opening nozzle, turning off dispenser, and closing switch at panel board.

As indicated in these test procedures, a sincere effort is made to insure the performance of our equipment and particularly to calibrate all to zero on gasoline. However, in spite of our effort, some are found to be several cubic inches off at installation. Of the possible causes for this inaccuracy, the variation of approximately 2 cubic

inches built into the computer is the best known and most widely discussed. As a consequence it is only being mentioned here.

A less known and less frequent cause is from rough handling during shipment. Such can and does distort the computer frame making the computer itself hard to turn. The resulting additional torque can produce calibration differences of about 2 cubic inches which may be either plus or minus depending on the make of the meter.

Probably the greatest of all causes for initial dispenser mismeasurement lies with the ever changing additives in gasoline. As in the incident mentioned earlier, they make the use of any sort of preservative very questionable. Yet, without some protection, a dispenser that has been in storage for as long as six months can be expected to measure at least plus 5 cubic inches, but to drop back to zero after pumping approximately 500 gallons.

Many of these additives are metal cleaners and as such are reactive to metals in general. Their reaction is not corrosive, but apparently etches out of the meter valve and valve seat metal grains which cut both. When this happens, the slow-flow calibration goes up in the test can with some meters and down with others.

With the additives and other changes in gasoline, the 2-cubic inch differential between them and our test liquid becomes less certain. Results of recent tests indicate that while there is little difference in viscosity, lubrication, and liquid film thickness, the adhesion of the gasoline film to the meter valve and valve seat is considerably less. This reduced adhesion allows more gasoline than naphtha to slip through the valve cover, thereby increasing the calibration.

To verify these findings, the controlled grinder marks, long considered necessary for lubrication, were machine lapped off a valve and valve seat. In addition, the edges sharpened by the lap were left to shear away the film allowing metal to metal contact. The valve and seat were then tested in a meter which calibrated the same on naphtha as on several different gasolines.

What ever the cause of calibration variation, the parts most often affected are the meter valve and seat. For this reason different materials are being tested continually in the hopes of finding the ultimate combination. While such appears unlikely for the moment, at least the problem is better defined.

Since these tests with meter valves indicates some difference in the wetting properties of gasoline, it would be interesting to know if our test cans are likewise affected.

No discussion of this kind is complete without some reference to the inaccuracies caused by vaporization of the gasoline. In a dispensing pump on a conventional underground system, it occurs in the suction while pumping, and on a specific gasoline, is proportional to suction, atmospheric pressure, and temperature. Thus the amount of vapor,

which must be removed from gasoline before metering, varies, but is efficiently handled by the air separator.

While separators are very efficient devices, there is always a critical volume of vapor which cannot be completely separated. In ours this critical volume is equivalent to the quantity of air that will pass a .030 inch orifice in a suction line with a vacuum of 8 inches of Hg. As indicated previously in our test procedures, the resultant inaccuracy amounts to 3 cubic inches.

The performance of separators have not been affected with the change in gasolines. However, the use of larger tanks and longer lines have increased the suction and consequently the vapor which must be eliminated.

In addition to vaporization from suction, vapor from summer temperatures is formed in the measured fluid line of the pump and in the lines from the check valve in the submersible pump head to the nozzle of the pedestal. With no provision for its elimination in either's lines, it represents a slight reduction in calibration. As to the extent of this reduction, calibration tests made in the cool of the morning and the heat of the day indicate 2 cubic inches reduction for the pump and 5 cubic inches for the pedestal.

While testing in the heat of the day, it was noted that the location of the nozzle spout in the neck of the test can could make a difference of 2 cubic inches in the calibration of the pedestal, but no difference in the calibration of the pump. If any conclusion could be drawn from this limited information, it was that with no separator in the pedestal to remove the light ends, the gasoline was vaporizing in the test can.

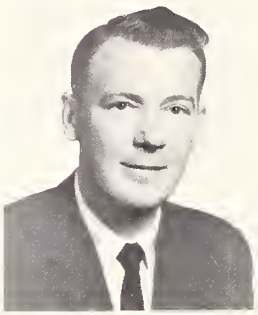
To prove these differentials in measurements resulted from vapor only, our meter was tested in temperatures ranging up to 165° F. and was found to be consistently accurate.

Like vapor, wear is often mentioned as a cause of inaccuracies. While such is certainly true, our experience overall shows that problems of this type are being slowly reduced through the use of new materials.

These comments, which were merely a list of facts and experiences, illustrate the ever changing nature of our problems. Their solutions are often perplexing and require the understanding of all concerned.

BIG INTELLIGENCE FROM LITTLE NUMBERS

by E. E. Wolski, *Manager of Quality Control, Colgate-Palmolive Company, New York, New York*



As you know, I attend this Conference as a representative of industry. I am sure you appreciate that the most valuable assets of any company are its reputation for fair dealings and the integrity its trademarks imply. My own company has the reputation of being in business continuously and serving the public well for 160 years. We, as a company, guard that reputation zealously. To live up to our company slogan, "Quality Products Since 1806," is a continuing objective of our management and must be the concern and responsibility of every employee. My assignment within the company is nationwide management of the Quality Control Program for all my company's products. A major part of that program is weights and measures control.

Weights and measures law enforcement is not a burden to a capable manufacturer. Far from being a burden, these laws do not restrict their protection to the consumer—in these days of fierce competition they also protect the conscientious manufacturer from those who are unable to comply or unwilling to administer the controls which guarantee compliance.

What is compliance? We market our products in all fifty States. Although the laws and regulations may vary somewhat from State to State, they all require that the average fill must equal at least the labeled quantity, and sampling must show the filling operation is maintained under control. A packager should only need to control his operation within reasonable tolerances and give fair and honest measure.

Manufacturers ask themselves the questions, "What is the best control?" and "Can I improve?" At the same time weights and measures officials are faced with the problems of identifying the capable packager, and of identifying those who need assistance to comply or to eliminate excessive and costly overfill. The answers to all these questions are in statistical control of net fill and statistical evaluation of the resulting production.

A relatively few numbers and some interpretation of them can yield a great deal of information—"Big Intelligence from Little Numbers."

Let us look at the manufacturer's problem first.

One of the primary considerations in the control of any manufacturing operation is that no two things will be exactly alike in every detail. There is variation from unit to unit; and this variation may

be large or small, depending upon the precision of the overall process or operation. The variation in the overall process or operation includes not only our ability to control it, but our ability to measure the results accurately. For example, if we were to have several chemists perform an analysis of the same material, we would not get exactly the same result every time. The same thing is true of a process or a filling operation. We may be operating at the specified value, but the individual units will vary about it. It does no good to adjust the operation unless the result is far enough from the standard value to give evidence that the average has actually shifted.

The degree of variability inherent in an operation can be estimated by making use of statistical methods. Statistics is a system of techniques by which conclusions and predictions can be drawn from numerical data. It is based upon the mathematical theory of probability. In our operations it is used to determine the point where action should be taken (rejection or adjustment, for example). These points are established at values where the odds are that our operation has wandered from the desired control, and an adjustment is required to correct for the shift; values are also determined which serve as the basis for rejection of any goods produced at that level.

There are a number of terms which must be understood for practical application of statistical techniques (fig. 1).

X (or, the value): The observed individual result for each unit measured.

Frequency: The number of times a given value for X is observed out of the total of all the observations recorded in the *frequency* (f).

Frequency Distribution: A tally of the number of times each value occurs, to illustrate the pattern of the variation.

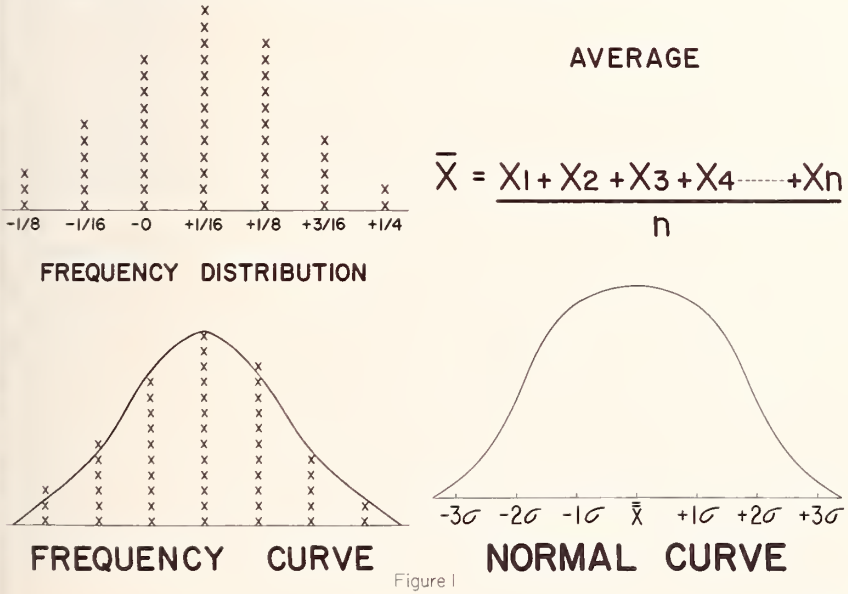


Figure 1

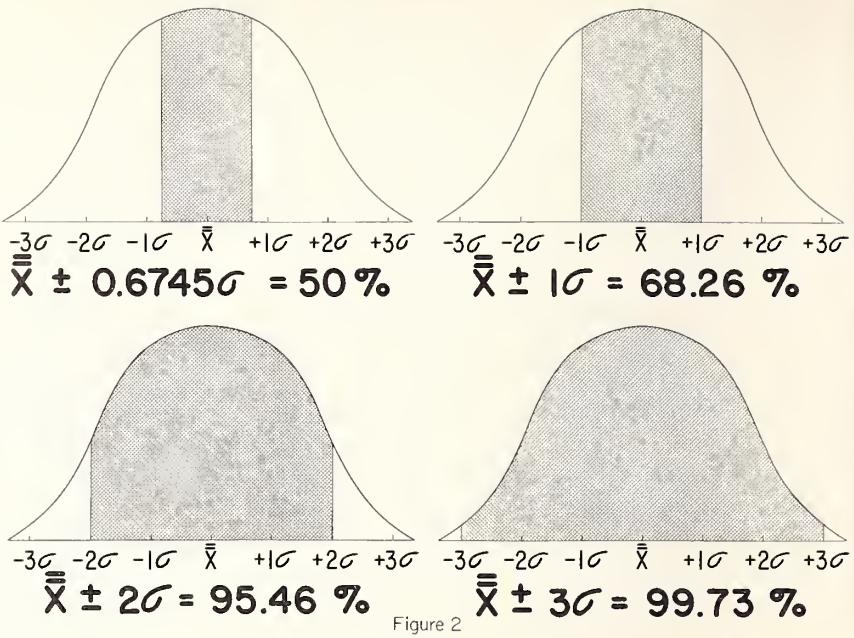


Figure 2

Average: The arithmetic mean of the individual values.

Standard Deviation: A mathematical relationship of the individual samples to the average value. This is one of the most useful measures of the degree of dispersion and permits one to predict what future samplings will show. The Standard Deviation, "sigma" (σ), is the root-mean-square deviation of the values from the average.

Range: The difference between the largest and smallest observed values in the range (R).

Frequency Curve: The frequency distribution, if it included a large enough number of observations, would eventually widen to include some of the values which occur less often and would ultimately describe the true distribution of values for the process under study. If we were to construct a smooth curve connecting the tops of the frequency tallies, the height of the curve at any point would be proportional to the frequency at that point, and the area under the curve between any two limits, compared to the total area under the curve, would be proportional to the frequency of occurrence between these limits. Such a curve is called a frequency curve.

Normal Curve: The frequency curve which occurs most often is symmetrical and bell-shaped. If the X values are stepped off in terms of the standard deviation, practically all the area under it is included between the limits $X \pm 3\sigma$.

The most commonly used limits (fig. 2) are:

Limits	*Percent of Total*
$X \pm 0.6745\sigma$	50.00
$X \pm \sigma$	68.26
$X \pm 2\sigma$	95.46
$X \pm 3\sigma$	99.73

This means that in those distributions which roughly approximate the normal curve about two-thirds of the occurrences fall within one standard deviation on either side of the average, all but about 5 percent fall within plus or minus two standard deviations, and practically all fall within plus or minus three standard deviations.

Control Charts: A control chart is prepared by determining the limits which represent the spread the process would normally exhibit if it remained at the desired average value. Observed weights are plotted to provide a record of the sampling. When an observation is outside the established limits, correction is made. If not outside the limits, it represents the expected normal variability and no adjustment should be made. Unnecessary adjustments only serve to shift the average from the desired value and to increase the process spread. The only way to reduce the variation of a system is to reduce its standard deviation, and this requires a significant modification of the process.

Now, let us look at how a packager solves the problem of controlling fill. My company has an official statement of weight policy which is the responsibility of those who manage production. I would like to quote from this:

> It is the policy of the company to deliver fair measure to our customers at all times.
>
> To accomplish this, filling targets must be set at values which assure that all production averages marked quantity or more.
>
> There is a certain amount of variability inherent in the filling operation. Therefore, operation must be controlled at the correct target value, to not only protect against production of unreasonably light packages due to excessive variation, but also to protect against unreasonably heavy packages, since some States, counties, and municipalities enforce regulations which prohibit overfilling.

Even the most modern high-speed fillers available today, which approach the ideal of perfection in uniform, fill, still never meet it. As can be seen from the analysis of statistical data, they do reduce the variation and are actually more accurate than manual weighing for production quantities. But the laws of nature say some variation will always exist, and the degree of variation can be determined and predicted, and the operation controlled to maintain good performance.

It is first necessary to evaluate each production line for each product and size which is filled. A study is made to determine that the filler is

in first-class mechanical condition and adjustment. Consecutive samples representing all the filling stations in the filler are obtained by several cycles or revolutions of the filling head. The net fill of each individual unit is obtained and plotted, showing the variation as compared to average.

A repetitive pattern with one or more stations consistently off shows a need for mechanical adjustment or repair.

A completely random distribution about the average shows the machine to be in good order and ready for an evaluation as to its capability.

A minimum of twenty-five subgroups of consecutively produced samples are taken at five-minute intervals while the filler is in production. The number of samples per subgroup is equal to the number of stations in the filling head. Each individual sample is weighed and a frequency distribution developed. If a normal distribution is obtained, we may then calculate, statistically, the target which will provide protection against an excessive number of unreasonable minus errors. As the random distribution can be narrowed by significant changes in the operations, this target approaches marked quantity. About two-thirds of our filling lines are sufficiently precise and controllable to such a degree as to allow filling at label quantity as a target. On the other hand, to keep unreasonable minus errors at the required minimum, we are obliged to overfill on other lines. This overfill target requirement is determined in the same manner and may vary from only a few hundredths of an ounce up to an ounce on the larger sizes of certain products.

From these capability data, we set up the control limits for the line operator. These are also used by roving inspectors to randomly check filler performance against the target to verify that the operator has maintained control. Most lines are of such design as to permit installation of automatic reject devices. On other lines we hold all warehouse goods for the periods when these independent inspections show reject levels. This is accomplished by identifying stocks through an imprinted shipping case time code. All such held stocks are inspected and evaluated on the same basis as at the filling line. Rejects are reworked by sorting and the unacceptable merchandise is scrapped.

Fillers are reevaluated at regular intervals as a standard practice. In addition, such equipment checks are also made when the inspection data may indicate the possibility of a malfunction. Even with systematic maintenance and control, many factors (normal machine wear, for example) will gradually alter the capability of the operation.

We are in the process of making a trial installation of an original design system. This will permit collection of filling data on magnetic tape, with automatic conversion of these data for computer processing and continuous monitoring of each line's capability. Revisions to tar-

gets can then be made on an even more controlled basis, and the need for maintenance can be spotted even sooner.

Industry does cooperate and spends literally millions of dollars in equipment, inspection, maintenance, scrap, reword, and other costs to do a good job in controlling net fill.

Now, let us look at the questions of the weights and measures officials. These were:

1. Who are the capable packagers?
2. Who are those who need assistance to comply or to eliminate excessive overfill?

It is relatively easy to determine what a packager's ability and intent are. Such big intelligence is readily available from a few little numbers. In fact, as you would expect, we routinely sample our own and competitive goods at retail not only to further police ourselves but also to evaluate our competition. Believe it or not, if a competitor makes a significant change in his filling operation or his policy, it will not be long before we are aware of it. And I am sure he keeps as well informed regarding our operations.

The results of inspections should be plotted as a frequency distribution, and the plot retained in the file related to that packager. After at least ten inspections are plotted, the data can be readily analyzed as follows (based upon the usual sampling of ten units):

1. Determine the average and the range for each of the samplings.
2. Determine the overall average and the average of the ranges.
3. Estimate sigma $-\sigma=\overline{R}/3.078$.
4. Step off plus and minus 1σ, 2σ, 3σ on the frequency distribution.
5. Evaluate:
   (a) Is the overall average at or above the marked quantity?
   (b) Are about $\frac{2}{3}$ of the values between $\pm 1\sigma$?
   (c) Are only a very few outside $\pm 3\sigma$?
   If (a) is answered "yes," he gives fair measure.
   If (b) and (c) are answered "yes," he has control.
   If (b) and (c) are answered "no," he needs assistance to improve his program.
6. What is his intent?
   If he averages marked quantity or more, he obviously has the intention of giving fair measure.
7. How successful is he in controlling unreasonable minus errors?
   If we subtract the label quantity from the overall average, the result is his overfill. To determine how his overfill relates to his filling control capability, we add the reasonable error to the overfill to determine how much above the reasonable error his fill actually averages. Dividing this result by the sigma which has been estimated, gives his "POTENTIAL ERROR."

If his "POTENTIAL ERROR" is:	
3.5	he has practically no units below unreasonable error
3.0	he has $\frac{1}{10}$ of 1 percent below unreasonable error
2.33	1 percent
2.05	2 percent
1.88	3 percent
1.75	4 percent
1.65	5 percent
1.28	10 percent
1.04	15 percent
0.84	20 percent
0.50	30 percent
0.25	40 percent

It should be borne in mind that these are estimates and are subject to the errors which sampling can introduce. I am sure most of you recall the Presidential election of 1948 where Mr. Dewey retired for the night with everyone positive he had been elected in a landslide victory. When all the votes were in, Mr. Truman had been chosen. Nevertheless, in practically every case, you will find that packagers with a properly designed program will usually show evidence of good control, will show average quantity to be at least label quantity and their potential error will be at a reasonable level. Likewise, illegal practice will usually be shown if it exists as will the results obtained by the honest fellow who tried but needs a little help.

I am sure you will find that, as you apply these techniques, they take but little time while providing a great deal of assistance in deciding where best to direct your efforts to obtain better enforcement of the laws.

It is, indeed, true that the result can be "Big Intelligence from Little Numbers."

Remarks of Mr. J. H. B. Hornby, *Deputy Chief Inspector for Weights and Measures, Oxford, England*

Mr. Chairman, just a bicycle ride from my home on the outskirts of Oxford lies the body of the greatest Englishman the world has ever known, Sir Winston Churchill, in an English country churchyard. Now there is, you understand, in England, a great love for this magnificent and colorful man, and a lot of money has been contributed by a lot of people to a fund which was established in his memory to send a number of men and women to the countries of their choice, from time to time, to make a study of their own particular jobs. This is known as the Winston Churchill Memorial Traveling Fellowship Scheme. I applied, 3 months ago, for one of these fellowships to come to your country and to Canada to make a study of consumer protection for a period of 6 months.

I am more than conscious, Mr. Chairman, of the responsibility this imposes on me, having spent so much money to send me out here. But I draw some consolation from the words of Sir Winston Churchill himself, who, when he received one of his many awards, said, "I am proud, but also awestruck, in your decision to include me. I feel we are both running a considerable risk and I do not deserve it, but I shall have no misgivings if you have not."

Having said what I am here for, I suppose I ought to tell you what I am not here for; that is, to have a holiday. My friends in England said that one of my greatest difficulties in the next 6 months will be fending off the hospitality of the kindly American people. This does not mean that I shall always say "No" to all kindnesses automatically. I am sure you will understand I am here to work and work pretty hard. I have a full program ahead. I am here, gentlemen, to pick your brains, to ask questions, and to find out what America does, how, and why. If it seems that all I do is ask how and why and when and what for, then I am sure you'll understand. Please bear with me.

Mr. Chairiman, Mr. Reg. Roberts, of the Manchester Weights and Measures Department, is the permanent chairman of our own professional organization, the Institute of Weights and Measures Administration. Before I left, he asked me to convey to you and the Conference the greetings and best wishes of the Institute for a happy and successful Conference here in Denver. This I now do with pleasure and honor.

You have also seen, I think, other distinguished members of the English Weights and Measures Service; Mr. Gray and Mr. Gregory

come to mind. These are men who have spent a lifetime in weights and measures. They are at the top of their profession and experts in every way. Please do not confuse me with them. I am no expert. I have been in this job a third of the length of time they have. I am here more as a student than as a teacher and an expert.

You have no idea how much I look forward to the next 6 months. I want to talk to as many of you as possible and see as many of you as possible. Thank you again for all your kindnesses and for listening so attentively.

(Mr. R. E. Meek, of Indiana, supplemented Mr. Hornby's remarks with a brief description of Mr. Meek's visit with the British Weights and Measures Administration, at Torquay, England.)

(Following Mr. Hornby's remarks, an Open Forum was held, moderated by Mr. M. W. Jensen, where the floor was declared open to the Conference attendees. The delegates were free to discuss any administrative or technical problems that the rest of the busy Conference program might have precluded.)

AFTERNOON SESSION—THURSDAY, JULY 14, 1966

(E. H. Black, *Vice Chairman*, Presiding)

(Thursday's afternoon session was devoted to reports of the Conference committees, which can be found beginning on page 131.)

MORNING SESSION—FRIDAY, JULY 15, 1966

(J. F. True, *Chairman*, Presiding)

TECHNICAL PROGRAM OF THE OFFICE OF WEIGHTS AND MEASURES

by M. W. Jensen. *Chief, Office of Weights and Measures, National Bureau of Standards*

During each of the past few years, we have presented to the Conference a report of the Office of Weights and Measures which was made up of individual reports from several of the professional staff members. This year, because the major emphasis of our program was on the new State standards project, I will report to you briefly on the overall program and will be followed by a report in some detail from Mr. Stabler on the standards project.

We now are located in the Administration Building of the new facilities of the Bureau at Gaithersburg, Maryland. We have had the pleasure of visits from a few of you, and I hope many of you will be able to see these facilities in the near future. On this point, the executive Committee agreed this morning to recommend to the Conference that it meet in 1967 in Washington and that there be included in the program a tour of the new NBS facilities.

With respect to our activities, we still find it necessary to devote a seemingly large portion of our days to communications—both letters and oral. The number of visitors to the offices has dropped off some since our move to Maryland, but those who desire to consult with us seem to have no difficulty in reaching the facility some 25 miles northwest of the Capital.

Technical training continues to be a major activity and we hope a major contribution. Through the years there has been a gradual increase in the requests for our assistance in technical education. We hope this increase will continue.

We have underway at this time a number of technical investigations, including proving techniques and technical requirements for liquid meters dispensing liquid fertilizers and for vapor meters in LP-Gas service.

We have continued a search for a more stable material with a better surface from which to make testing tapes for fabric-measuring devices. (We have found what appears to be an almost ideal material, but it presently is too expensive for this use.)

Yesterday morning, during the open discussions, there was some mention of recent developments in the metering of milk. Dr. Ed Glass,

of Pennsylvania State University, who devoted his graduate studies to milk metering, still is studying in this area. We will be keeping in close touch with the work and will report to you as real progress becomes evident.

There also was some mention yesterday of plastic cartons for milk and of a preliminary introduction of such cartons for reusable service. None of the plastic cartons submitted to us for examination has been such that they could be considered "milk bottles." It, accordingly, is our view that these must be considered as containers only until tests prove definitely that they have measurement characteristics and other capabilities to meet all requirements of the Code for Milk Bottles.

Cooperatively with selected weights and measures jurisdictions, we are entering into a rather broad study on the effects of evaporation on the official testing of meters. The attempt here is to determine, with precision, whether our present test measures and liquid provers adequately reflect the commercial delivery of meters. As a simple example, a retail motor-fuel dispenser delivers its product into a fill pipe of an automobile averaging 1⅜ inches in diameter, whereas the five-gallon test measure with which the dispenser is officially tested has a neck of four inches diameter. We are attempting to determine whether there is sufficient evaporation during a test to affect the accuracy of the test as we attempt to "duplicate service conditions of operation."

As many of you know, we have continued throughout this past year our policy of attending and participating in all State and regional weights and measures conferences. In addition, we have appeared on the programs of quite a number of industry meetings.

In the future, because of budget limitations and a strictly imposed traveling ceiling, it will be necessary for us to establish certain guidelines covering our participation in meetings and conferences. To the extent that we are invited, we will be present at regional weights and meaures conferences. We will attend only those State meetings at which we feel we can make a definite contribution. In most cases, our participation in meetings of industry will be limited to those where the industry underwrites travel costs.

The NBS railway track scale program was transferred to us about a year ago. In this area, we accept as our principal responsibility the operation of the facility at Clearing, Illinois, and the calibration of the 19 master track scales, which have the function of standardizing the test cars used by the railroads. We hope during the coming year to study this entire field very carefully and to establish a program that operates effiicently and effectively with a minimum outlay.

Our calibration load continues at a reasonably high level. In the laboratories of the Office of Weights and Measures we undertake the calibration of all except the reference standards of the States, including a number of special standards for industry.

Our publication output during the past year was somewhat lower than we would have desired. New Handbook 44 and the Conference Report were issued as were a number of Weights and Measures Tech Memos. We completed a rewrite of Miscellaneous Publication 233, which is the basic publication covering units and systems of weights and measures and tables of conversion for both the U.S. Customary and Metric units. Considerable progress has been made in the revision of Handbook 67, Checking Prepackaged Commodities. We hope to have the manuscript revision in the hands of the printer by fall with a target publication date of early 1967.

In mentionong the Tech Memo, I am constrained to point out once again that this system of communication can really succeed only if it is bidirectional. We receive very little from weights and measures officials. I urge you to keep the Tech Memo in mind and to bring to our attention anything you have encountered that you think might be of interest to other officials.

Our professional staff has gained two and lost one since the 50th National Conference. We are pleased to have had join the staff Charles Schreyer, a highly capable physical chemist, and Harry Johnson, who, undoubtedly, is one of the very best calibrators in the nation. Donald Mackay left us to become Chief of the Office of Engineering Standards Services. Fortunately, Don still reports to me.

As I mentioned at the beginning, our major effort during the year has been in State standards and State laboratories. You will hear next a report on this project from the individual most intimately connected with it, Tom Stabler.

STATE STANDARDS AND LABORATORIES

by T. M. Stabler, *Laboratory Metrologist, Office of Weights and Measures, National Bureau of Standards*

Abstract.

The program of the Federal Government to supply new standards and instruments to each State is now underway. Ten States have been chosen to receive them beginning this winter. These States have had to provide suitable laboratories and qualified personnel to perform the calibrations and to promote measurement. The National Bureau of Standards will assist the States in the establishment of the laboratories and in the training of the technologists. The final goal is to have established the State Measurement Center in all 50 States.

New State Standards Program.

The program of the Federal Government to supply new standards of mass, length, and capacity, and instruments to each State got underway during 1965 when the Congress appropriated $400,000 to supply the first ten States. The standards are now being manufactured, and the ten States have been chosen to receive them beginning this winter. These initial accomplishments, however, are only the beginning of a far-reaching program that is now in the early stages of development.

The New State Standards Program is designed to equip the States so that they may become significant elements in "The National Measurement System," which will include the National Bureau of Standards at the Federal level, regional government laboratories, 50 State weights and measures laboratories, industry laboratories, and education and research institutions. This will be a highly integrated system of measurement laboratories and ultimately will effectively serve the local or "grass roots" institutions.

The demand for better measurements and measurement service in this general area is far greater than can be provided by a central governmental agency. One outgrowth of the measurement demand is the National Conference of Standards Laboratories which held its third meeting in May at the Bureau's new site in Gaithersburg, Maryland. Several hundred people interested in standards and measurement met to exchange information concerning laboratories, and laboratory operations. (This organization, also sponsored by the National Bureau of Standards, may develop an "associate" relationship with the National Conference on Weights and Measures.)

The State weights and measures laboratories will have an increasing responsibility and will play a major role in the National Measurement System. As in the past, the National Bureau of Standards will continue to maintain the primary responsibilities, the national standards for measurement, including research and development of measurement techniques. The Bureau will lend whatever technical assistance is necessary in the development of a State measurement center—of the 50 State measurement centers.

Such a State weights and measures laboratory will, in turn, serve the State government; its commerce and industry, and its educational and research institutions. It will perform tests on all State field standards of mass, length, and volume used by the weights and measures inspectors, and also on standards used in the many other State agencies such as, for example, by the State chemist, veterinarian, dairy, feed and fertilizer inspectors, seed inspectors, botanists, public health inspectors, and petroleum laboratory technicians.

The commerce and industry of a State may well be the largest users of the weights and measures laboratory capability. Manufacturers,

producers, and buyers and sellers of commodities must know that their products meet certain measurement criteria. This is basic to quality and quantity control. Measurement control is essential in all trade, and the bases for this control are the physical standards of length, mass, and volume. Obviously, an important service to industry will be testing of standards used by firms within the State engaged in the manufacture, repair, and maintenance of commercial weighing and measuring devices.

It is essential that the State weights and measures laboratory be capable of serving as the measurement center for the State. This requires first that the physical standards of the State, those that are directly related to the national standards, must be maintained and used under carefully controlled conditions.

The laboratory technologist must have an appropriate background and must be trained to utilize fully the accuracy built into the new standards. He will, in fact, be the key to the successful operation of the precision measurement center. He will be responsible for the operation of the laboratory, for the care and maintenance of standards, and for the calibrations. To fulfill his role, he will have to fully acquaint himself with his field and to pursue a continuing course of study in measurement science. He must be a career professional in every respect.

At the time these new standards and instruments are delivered to and and installed in a State, the Office of Weights and Measures will assist in the initial training of the technologist. He will be introduced to calibration procedures and will be taught the care, maintenance, and use of the precision instruments. As the calibration program develops the technologist will receive additional training at the State laboratory, and, as he advances, he will have the opportunity to attend regional training schools at other State laboratories. His final "graduate" studies will be in the laboratories of the National Bureau of Standards. Laboratory learning will be truly a continuing effort.

The standards delivered to the States will be the best present technology offers. Even so, they are only as good as the values assigned to them. Initial values for the standards will be given by the National Bureau of Standards prior to delivery to the State. After this, the technologist will maintain these values through intercomparisons of standards and through calibrations in his own laboratory.

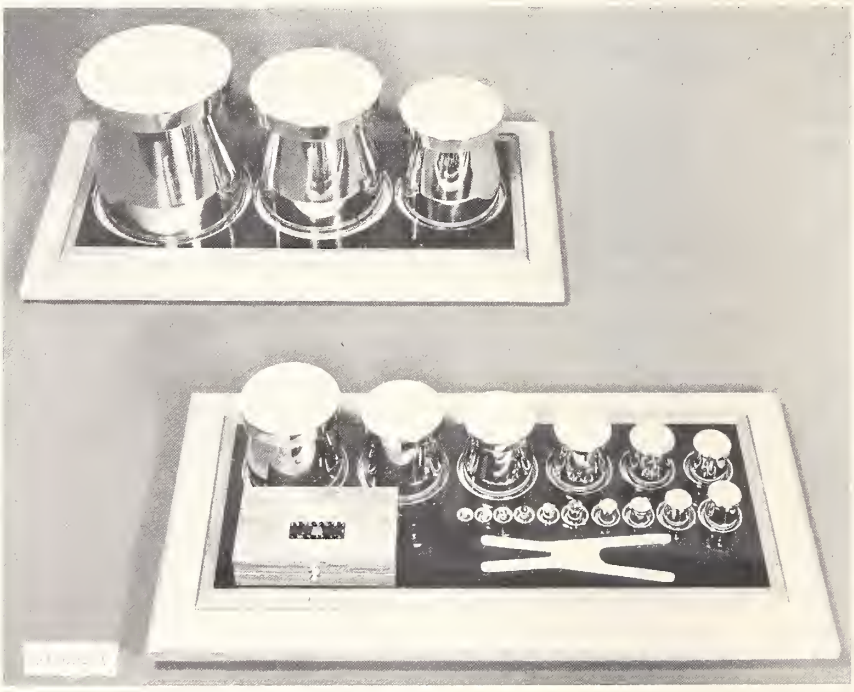
A second vital function of the metrology technologist will be the promotion of measurement capability throughout the State. He may plan an important role in finding the answers to such questions as: Is there waste in commerce and industry that could be eliminated through better measurement? Would this result in dollar savings and a better end product? With a smaller margin of profit in manufacturing, would closer control of measurements result in a better profit picture?

Would a different measurement technique result in labor saving? Will improved test equipment reduce service costs?

Another, and perhaps equally important, service to be performed by the technologist is that of measurement counsel. Questions will be asked: What kind of measuring instrument should a manufacturer purchase for a specific purpose? What is the best type of balance for a specific application? What classification of test weights will be most satisfactory? What technique will provide the greatest precision? How do I ascertain the accuracy of my volumetric measure?

Hopefully, one of the principal "customers" of the measurement services provided by the State laboratory will be the educational institutions. The chemistry, zoology, physics, engineering, agriculture, medical, pharmacy, athletic, and many other departments of a university have particular measurement needs and measurement problems. The universities will, of course, be providing the basic training for all laboratory technologists and hopefully for all weights and measures officials in the future.

The final and an essential element of a State measurement center is the *promotion* of measurement. In some cases this will be a major responsibility for the department's administrators and in others it will be the responsibility of the technologist. In order to identify and meet the measurement needs throughout the State, and to develop measurement capability, a vigorous promotion of measurement will



be initiated and sustained. And this promotional effort will take many forms and will require much initiative.

In order that the technologist may develop and prove a competence in his laboratory measurements, the calibration capability of the State laboratories will be evaluated through a standards comparison program. The National Bureau of Standards will supply carefully calibrated standards of mass, length, and capacity to the State laboratories for measurement. The reports of the States will be compiled and the results compared. The NBS confidential report to a State will give an analysis of the calibration results of that State and appropriate information on comparability of other States.

And so the plan and the program unfold perhaps as exciting a chapter in weights and measures as has been encountered to date.

The first ten States to receive standards have been selected. They are: California, Connecticut, Delaware, Illinois, Kentucky, New Mexico, Ohio, Oregon, Tennessee, and Utah. They were selected on the basis of their fulfilling the requirements for physical preparedness, need, and the availability of a (fulltime) qualified technologist.

The total "package" (fig. 1) includes the following:

1. Sixty-seven mass standards (metric and avoirdupois) 30 kilograms to 1 milligram, and 50 pounds to 0.000 001 pound of 8.0 g/cm^3 stainless steel.
2. Two 500-pound stainless steel, type 303, stacking weights.
3. One 25-foot, 7-meter precision steel tape with engraved graduations.
4. One 100-foot, 30-meter steel tape.
5. One 16-foot, 5-meter stainless steel length bench, precision microscope, tension weights, and other accessories.
6. One 18-inch steel rule graduated in hundredths, sixty-fourths, thirty-seconds, and sixteenths of an inch.
7. Sixteen "automatic" volume standards including 12 pipets and 4 burets, 5 liters to 1 milliliter and 1 gallon to 1 minim.
8. One 5-gallon, stainless steel volumetric standard with slicker plate.
9. One 100-gram capacity, single pan, semiautomatic precision balance with 8.0 g/cm^3 stainless steel built-in weights.
10. One 1-kilogram capacity, single pan, semiautomatic precision balance with 8.0 g/cm^3 stainless steel built-in weights.
11. One 3-kilogram capacity, single pan, precision balance.
12. One 30-kilogram capacity, single plan, precision balance.
13. One 2500-pound capacity, equal-arm, precision balance.
14. Designs of State weights and measures laboratories.

Conclusion.

The new State standards program is one that should benefit, directly or indirectly, every citizen of the United State. Its real success

will depend largely upon the initiative, the industry, and the enthusiasm with which the States participate and contribute.

Weights and measures supervision has been cited as the finest example of Federal-State relationship in the Nation.

This program of standards and laboratories, this concept of responsible roles in the National Measurement System is another opportunity, and an extremely vital one, to demonstrate a cooperative and coordinate Federal-State activity that is truly in the public interest. It is a challenge that we at NBS will accept with pride and dedication.

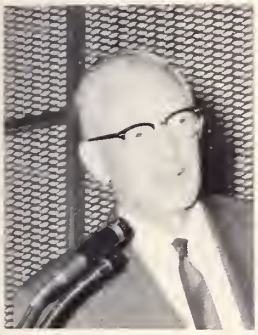
(Following Mr. Stabler's address were the reports of the Conference Committee on Resolutions, Auditing Committee, Treasurer, and Incoming Executive Committee. The Conference then discussed the "Activities of the Conference Standing Committees" where questions were directed to the Standing Committee Chairmen and the Executive Secretary by the delegates. At the conclusion of the discussion, Chairman True presented the gavel to the incoming 52nd National Conference Chairman, J. E. Bowen of Massachusetts. The benediction was then delivered by the Conference Chaplin, Rev. R. W. Searles. Thereupon, at 10:32 a.m., the 51st National Conference on Weights and Measures was adjourned, *sine die*.)

REPORTS OF THE CONFERENCE COMMITTEES

REPORT OF THE CONFERENCE EXECUTIVE COMMITTEE

presented by J. F. True, *Chairman, State Sealer, Division of Weights and Measures, State of Kansas*

(Tuesday, July 12, 1966, 2:12 p.m.)



The Executive Committee of the National Conference on Weights and Measures met in open session on July 11, 1966, at 8:30 a.m. Items discussed were the Conference location, dates, program, program length, and the possibility of holding at least one of next year's sessions at the new facilities of the National Bureau of Standards at Gaithersburg, Maryland.

There was a positive recommendation by the Committee that the 1967 National Conference be held in Washington, D.C., during June.

The Committee deemed it advisable to leave the matter of Washington hotel location open, pending the best possible arrangements that the Executive Secretary can make for the conference delegates.

The Committee felt that both program length and format have been satisfactory and recommends no change at this time.

Considerable interest was expressed in the possibility of holding at least one 1967 Conference session at the new NBS-Gaithersburg facilities and in touring the new facilities. There is great interest in holding the entire Conference at the National Bureau of Standards at such time as appropriate lodging facilities become available.

The Executive Committee was presented with no evidence that would indicate a need at this time for a change in the registration fee.

J. F. True, *Chairman*
E. H. Black
L. L. Elliott
M. Jennings
J. L. Littlefield
C. C. Morgan
R. W. Searles
A. J. Albanese
L. A. Gredy
J. G. Gustafson
M. W. Kinlaw
H. K. Sharp
F. F. Thompson
L. W. Vezina
A. W. Weidner
W. W. Wells
E. C. Westwood
M. W. Jensen, *Secretary*
Executive Committee

(On motion of the Committee Chairman, seconded from the floor, the Report of the Executive Committee was adopted by voice vote.)

STATEMENT OF THE INCOMING CONFERENCE EXECUTIVE COMMITTEE

presented by J. E. Bowen, *City Sealer of Weights and Measures, Newton, Massachusetts*

(Friday, July 15, 1966, 10:05 a.m.)

The Executive Committee for the 52d National Conference met for breakfast at 7:30 a.m. on Friday, July 15, 1966, to consider matters falling appropriately within its authority. Decisions were reached as follows:

1. The dates June 25–29, 1967, were voted as the most favorable for the 52d Conference.
2. The City of Washington, D.C., was chosen for next year's Conference. It was left to the discretion of the Executive Secretary to choose those hotel accommodations most favorable to the Conference delegates.
3. The registration fee will remain at $15.00.
4. An allocation of $400.00 was voted for the Committee on Education for expenses associated with National Weights and Measures Week and other committee expenses.
5. The responsibility for planning the program of the 52d Conference was delegated to the Executive Secretary, with a suggestion that consideration be given to resuming the midweek Conference luncheon, with an appropriate guest speaker.

Several good suggestions for topics for next year's program were discussed. It was suggested that the Thursday morning Open Forum be expanded to allow more time for delegates to discuss matters with each other that the rest of the Conference program may preclude. Suggested new topics were: Calibration problems in the space age, Federal-State cooperation in metrology, record-keeping methods for weights and measures officials, a critical analysis of State weights and measures supervision, and the possibility of an Alfred Tech graduate describing the Measurement Science program.

It was also suggested that ideas be explored to find some method to consult with ladies who have attended this year's Conference on the planning of next year's ladies' program.

REPORT OF THE COMMITTEE ON EDUCATION

presented by S. H. Christie, Jr., *Chairman, Deputy State Superintendent, Division of Weights and Measures, New Jersey Department of Law and Public Safety*

(Thursday, July 14, 1966, 2:15 p.m.)

1. *Introduction.*

The Committee on Education is committed to a program of the technical training of weights and measures officials, the education along weights and measures lines of the general public and of users of weighing and measuring equipment, and the public relations programs for weights and measures organizations.

The Committee has been active during the past year, and through correspondence, telephone communication, and personal meetings of members when possible, has developed several topics for presentation in its report to the 51st National Conference on Weights and Measures.

2. *Formal Education.*

Alfred Tech, the Agricultural and Technical Institute of the State University of New York, has now graduated its first class in Measurement Science; twenty-five graduates have received an Associate Degree in Applied Science. They are well-qualified to step into the vacancies that industry is finding are becoming exceedingly difficult to fill.

Executives of the scale industry have continued to exhibit their interest in this program, which was initiated as a result of their activity. Besides the contribution of equipment for laboratory and lecture programs, many qualified individuals have played an important part through participation as guest speakers and lecturers.

It is an obvious fact that for this program to be really successful, financial assistance for desirable students must be forthcoming so that the Measursement Science Course can be competitive in its recruiting. A new Committee has been formed which is being chaired by the very energetic Mack Rapp. The goal is $100,000. Interested individuals, corporations, associations, etc., and particularly Weights and Measures Associations, should consider contributions to the Measurement Science Course Scholarship Fund. Contributions are tax deductible under a certificate of the Internal Revenue Service.

Your Committee notes with pleasure that plans for formal education are also being sponsored by the California Department of Education, the California Sealers Association, and industry representatives together. We understand that interest in establishing a Measurement Technology Course has been shown by Grossmont College in El Cajon. A committee formed by the California Sealers visited the institution and found a new, well-equipped plant with a very enthusiastic staff.

Your Committee wishes the California Sealers success and feels that the Conference records should show its appreciation for the efforts of this group, for it is by such means that additional formal education in weights and measures activities will be accomplished.

3. *National Weights and Measures Week.*

This portion of the Committee's program has been successfully handled in the past by means of subcommittee action. The same plan was used this year. John F. Madden, the then Director of Weights and Measures for the State of New York, was appointed as subcommittee chairman. A few months after his appointment, Mr. Madden resigned his position in New York State and from the Committee on Education. This left the Committee short one member and, of course, its subcommittee chairman.

Due to his success in the past in directing National Weights and Measures Week activities, in January of this year Lorenzo A. Gredy of the State of Indiana was appointed chairman of the subcommittee. The Committee is deeply grateful for his complete cooperation in directing this nationwide activity and for the preparation of the report which follows:

LORENZO A. GREDY, *Chairman, National Weights and Measures Week Subcommittee*

The primary purpose of Weights and Measures Week is to inform the public concerning the importance of the work of weights and measures officials in cities, counties, and States. Interest in the "Week" judging from the reports and from articles in the various newsletters indicates that this year's "Week" was a great success. We were able to reach more people than ever before.

Much of the material used in previous years, such as Governors' proclamations, newspaper articles, newspaper mats, displays, lectures, radio and TV spot announcements, and the films produced by the Office of Weights and Measures, was utilized again this year. The Committee on Education is indebted to The Scale Manufacturers Association for its assistance in providing several thousand Weights and Measures Week stickers.

Peter Grassi, Head of the Middletown, Connecticut Department of Consumer Protection, and Sealer of Weights and Measures, supplied a copy of the March 9, 1966 "Shopper News" which illustrates an outstanding local promotion. This paper, which has 7,500 circulation, features an editorial and pictures dealing with the successful observance of National Weights and Measures Week in Mr. Grassi's jurisdiction. Middletown sponsored a "Careful Shoppers" contest. In all, pictures of nine careful shoppers were featured on several pages of the newspapers. The use of contests can give impetus not only to the "Week" but can put the spotlight on the services of weights and measures officials.

All weights and measures officials are deeply indebted to Congressman John M. Ashbrook of Ohio for inserting in the Congressional Record on Monday, February 28, 1966, an article prepared by Dr. Leland J. Gordon concerning National Weights and Measures Week. Those of you who have not read the article or would like copies may secure copies of this February 28th issue of the Congressional Record by writing to your respective Congressman.

It is impossible to present the details of all the promotional ideas that were used during the "Week." The scale industry and others were very cooperative in furnishing pamphlets, posters, and display materials. This report, therefore, cannot be brought to a conclusion without thanking members of our Conference, both the weights and measures officials and associates, for their fine cooperation and for the interest shown in this very vital governmental activity.

4. *New Training Material Planned for the Technical Training of Weights and Measures Officials.*

The Office of Weights and Measures is planning the production of the third in a series of audiovisual self-training aids for weights and measures officials. This new training material will be produced in cooperation with the Packers and Stockyards Division of the United States Department of Agriculture and will give audio and visual instruction in a step-by-step procedure covering the complete examination of a typical livestock scale as recommended by the Office of Weights and Measures and the USDA. The Committee highly endorses this joint effort on the part of the two Federal Agencies and urges weights and measures officials to make widespread use of this training material when it becomes available.

The Committee also urges officials to continue their interest in and use of the two presently available training aids covering the examination of a computing scale and single-product motor fuel dispenser. The Committee is indebted to the editors of the various newsletters for their valuable aid in publicizing the availability of this material

during the past year. If present interest continues it will be possible to continue in the future to plan and produce similar presentations covering other commercial weighing and measuring devices.

5. *Technical Training Schools for Weights and Measures Officials.*

The Office of Weights and Measures has continued its established program of conducting technical training schools for weights and measures officials and has in fact had more requests for these schools during the past year than during any other similar period over the fifteen years the schools have been offered.

Since the last Conference twenty-two schools ranging from two to four days duration have been conducted in the various jurisdictions. These schools generally cover Handbook 44 requirements, interpretations of laws and regulations, and recommended uniform examination procedures for the various commercial devices. They can be tailored to fit the specific needs of any requesting jurisdiction. In addition, a Supervisor's Training School was held in Boulder, Colorado last August for the purpose of giving the Supervisors in the western States training that would qualify them to conduct similar classes in their own jurisdictions.

Also, staff members from the Office of Weights and Measures assisted officials in Bogota, Colombia in the installation and use of a complete set of primary laboratory standards. Field training also was conducted covering the basic weights and measures control of small commercial weighing and measuring devices.

The Committee on Education highly commends the Office of Weights and Measures on this widespread training activity and urges weights and measures officials to continue their increased interest and activity in this vital phase of their programs.

6. *Weights and Measures Newsletters.*

It has been noted that recent issues of various Newsletters have carried an increased amount of information which is of value to the weights and measures official in the field.

With this in mind, your Committee desires, once again to bring to the attention of the Directors of the several States the value of disseminating technical information through such "house organs." It must be remembered that both industry and labor organizations use this media as an extremely valuable informational tool, and it should not be overlooked by us.

7. *Development of Material for Use in Elementary and Secondary Level of Schools.*

Last year your Committee pointed out the great value of educating the public by starting the program in the elementary and secondary

school classrooms. The youngsters themselves not only become knowledgeable on the subject of weights and measures by this means, but through internal family discussions the parents also are made aware of these activities.

In many jurisdictions throughout the country efforts have been made along these lines. Apparently, all have been successful. It is admitted that the subject material discussed or shown must be tailored to fit the occasion. Consideration must be given to the type of courses offered by the school, the general business climate of the area involved, and to the inclinations and the status of the student body involved.

In order to be of service to weights and measures officials, and also in the hope of furthering public education by working through the school children, the Committee agreed to undertake the production of outlines and other suggested material to serve as a basis for weights and measures presentations at the elementary and secondary school levels. Sample outlines for use at the various grade levels starting with the 3rd grade and going through the 8th grade level are a part of this Final Report. It is the sincere hope of the Committee that weights and measures officials will make widespread use of this material and that it will be possible to produce similar material for use at the high school level next year. Weights and measures officials should encourage and solicit invitations to appear in the schools in their jurisdictions for the purpose of presenting weights and measures information.

8. *Commemorative Stamp—100th Anniversary of the Congress Recognizing the Metric System as Legal in the United States.*

Once again we were sorely disappointed in not having the United States Post Office publishing a commemorative stamp, recognizing the action of the Congress in making legal the Metric System in the United States 100 years ago.

If the desired stamp could have been produced in time for and distributed during National Weights and Measures Week, it is conceivable that the attendant publicity would have been beyond our fondest expectations. It is the Committee's opinion that with the interest being exhibited today throughout the entire world in the possible conversion to the Metric System, such a stamp would have been a real attention getter. The Committee also contends that our request answers the criteria required: First, that the 100-year period is a significant multiple of a 50-year desired base; second, that the subject matter is of prime importance to each and every member of our society; and last but not least, that our Congress itself is considering the matter.

9. *Professional Status of Weights and Measures Officials.*

With the careful planning of the program of the National Conference; the distribution of new physical standards of weights and measures to the States; the much closer contact of State officials with the research, development, and manufacturing segments of industry; the development of formal educational programs relating to measurement science; the requirement of traceability to the National standards of weight and measure in the reports issued as a result of the tests and inspection performed on various instruments and devices and physical standards utilized in the "standards rooms" of industry; the image and the status of the weights and measures official is growing fast.

Recognition of this is evidenced by a recent release, to which your Committee points with pride. The release was issued by the Instrument Society of America, of Pittsburgh, Pennsylvania, and informs us that under date of March 25, 1966, Mr. Roy J. Bierman, Manager of the International Division of Ramsey Engineering Company, St. Paul, Minnesota, has been appointed the Instrument Society of America (ISA) official representative to the National Conference on Weights and Measures, sponsored by the National Bureau of Standards. This announcement was made by Dr. John G. Truxal, ISA President and Dean of Engineering at Polytechnic Institute of Brooklyn. Mr. Bierman will serve for a two-year term.

We consider this a dynamic step forward since Mr. Bierman will exchange ideas with the National Bureau of Standards' Office of Weights and Measures to cooperatively develop and disseminate information on acceptable procedures for the use and testing of instrumentation for static and dynamic methods for weighing and measuring.

It should be remembered, too, that ISA is a scientific and technical nonprofit organization which is dedicated to the advancement of instrumentation through dissemination of information, stimulation of educational activities, and the development of standards and recommended practices.

We feel, therefore, that it is incumbent upon this Committee to give very careful consideration to the possibility of developing an acceptable program for the purpose of specifically defining what is professional status as it applies to weights and measures officials.

Prerequisites for this recognition might include such as: Attendance and participation in the National Conference on Weights and Measures and its activities; the learning of certain calibration techniques and legal requirements; and the successful completion of a course in the administration of weights and measures.

We should also consider the possibility of recognizing the services rendered by an individual in specific categories over a required period of time.

Sample Outlines To Be Used as a Basis for Weights and Measures Presentations at the Elementary School Level

Suggested Outline—3d–4th Grade Level

Theme—"Weights and Measures and Mathematics."

1. Explain in very broad and simple terms that practically everything we buy or sell has been weighed, measured, or counted to determine its value.
   1.1. Someone must be responsible for, first—establishing the basic units of measurement and, secondly—to make sure all weighing and measuring is done accurately.
2. Explain briefly our present system of weights and measures and how it came about.
   2.1. Our forefathers, when they settled this country of ours, brought with them customs and standards from the European countries.
   2.2. Great differences existed among these standards.
   2.3. The Federal Government had standards built and supplied each State with a set.
3. Demonstrate, with the use of field standards, what a pint, quart, gallon, inch, foot, yard, ounce, and pound really look like.
   3.1. With the use of standards like these men in each State check the weighing and measuring devices and packages that are used in commerce to make sure your parents get a gallon of gasoline or a pound of meat when they do their shopping.
   3.2. The men that do this checking are called Weights and Measures Officials.

Equipment Needed:

(a) Set of Class "C" weights from $\frac{1}{16}$ oz to 2 pounds.
(b) Several glass capacity measures, Class "C"
(c) Class "C" length measures, steel tapes, yard measure, etc.

References:

NBS Circular 593—"The Federal Basis for Weights and Measures"

NBS Handbook 82—"Weights and Measures Administration"

NBS Handbook 44—"Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices"

Suggested Outline—5th–6th Grade Level

Theme—"How Weights and Measures Control Concerns Every Citizen."

1. Show film "Assignment Weights and Measures."
2. Discuss local program in detail answering any questions film may have generated.
   - 2.1. Explain responsibility imposed by Statute.
   - 2.2. Show pictures or slides of various equipment and field activity.
   - 2.3. Explain any unusual situations encountered at the local level.

Equipment:

Copy of NBS film "Assignment Weights and Measures."
Copy of State law and local ordinance, if appropriate.
Slides of equipment and field activity.
16-mm sound motion picture projector and screen.
Tape recorder and slide projector.

References:

State law and local ordinance
Current program plan

Suggested Outline—7th Grade Level

Theme—"The Mechanics of Weights and Measures."

1. Show and explain how a computing scale works.
   - 1.1. Explain the test for accuracy of a computing scale using audiovisual aid and test weights.
2. Show and explain how a gasoline pump works.
   - 2.1. Explain the test of a single-service gasoline pump using audiovisual aid.
3. Show film "Assignment Weights and Measures."

Equipment:

Drum-type computing scale.
Single-service gasoline pump or series of slides, showing internal parts of a gasoline pump.
A few 1 or 2-pound test weights.
Audiovisual aids—"The Examination of a Computing Scale" and "The Examination of a Single-Service Motor Fuel Dispenser."
Film—"Assignment-Weights and Measures."
Tape recorder and slide projector.
16-mm sound motion picture projector.

References:

NBS Handbook 94.

NBS Handbook 44.
Set of Examination Procedure Outlines.
Literature from scale and gasoline pump companies explaining operation of respective devices.

Suggested Outline—8th Grade Level

Theme—"History of Weights and Measures Control in the United States."

1. The Constitution: Article 1, Section 8.
   1.1. Congress shall have the power . . . to coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures.
2. Lack of Congressional Activity.
   2.1. George Washington's first message to Congress, January 1790: "Uniformity in the currency, weights, and measures of the United States, is an object of great importance, and will, I am persuaded, be duly attended to."
   2.2. Thomas Jefferson was instructed to make a study and report suggested solutions to our measurement problem.
   2.3. No action on Jefferson's report until Surveyor Act of 1799.
      2.3.1. Each port was to examine and check their weights periodically.
      2.3.2. This Act was ineffective because there was no standard to use.
   2.4. John Adams made a classical report in 1821 in which he urged working toward a universal or international system.
      2.4.1. No action on Adams report.
3. The Mint Act of 1828.
   3.1. The Standard Troy Pound, used for regulating the weight of our coinage became our National Standard of Mass for a short time.
4. The Senate resolution of 1830 regarding standards of the customhouses.
   4.1. F. R. Hassler, Superintendent of Coast Survey, made comparison of standards and found wide discrepancies existed. Using information he obtained, Hassler went to work building a set of standards.
   4.2. Hassler chose—36 inch yard, 231 cubic inch gallon, 2150.42 cubic inch bushel.
5. Joint Resolution of 1836—Complete set of standards to each State.
6. Amendment to an appropriation act in 1838 to provide balances for each State.
7. Action by States adopting these Standards as the official State Standards.

8. Act of 1866 making the metric system legal.
9. The Metric Convention of 1875 establishing the International Bureau of Weights and Measures.
    9.1. U.S. became member and in 1890 received Kilogram 20 and Meter Bar 27.
10. The Mendenhall Order of 1893.
    10.1. Superintendent of Weights and Measures decreed these metric prototypes would be our National Standards.
11. The establishment of the National Bureau of Standards in 1901.
12. The Role of the States in Weights and Measures enforcement.
    12.1. NBS acts as custodian of our National Standards and furnishes States with values for their Standards.
    12.2. States exercise regulatory control over commercial weighing and measuring.
13. Show film "A True Standard."

Equipment:

World wall map.
Slides or original standards and balances.
Slides of new standards.
Slide Projector.
16-mm sound motion picture projector.
Film "A True Standard" (short version).

References:

NBS C–593—"The Federal Basis for Weights and Measures"
Bussey-Jensen paper—"Weights and Measures Administration in the U.S."
L.C. 1035—"Units and Systems of Weights and Measures—Their Origin, Development, and Present Status."
The Model State Weights and Measures Law.

The Committee takes this opportunity to publicly acknowledge its appreciation and to offer our sincere thanks to all who have so splendidly cooperated and assisted throughout the year.

S. H. Christie, Jr., *Chairman*
J. T. Daniell
L. A. Gredy
A. D. Rose
M. W. Jensen, *Secretary*
Committee on Education

(On motion of the Committee Chairman, seconded from the floor, the Report of the Committee on Education was adopted by voice vote.)

REPORT OF THE COMMITTEE ON LIAISON WITH THE NATIONAL GOVERNMENT

presented by A. L. Little, *Chairman, Head, Weights and Measures Division, State of Arkansas*

(Thursday, July 14, 1966, 2:36 p.m.)

At its organizational meeting in Washington the Committee decided to devote its energies during this first year of its operation to a matter deemed of utmost importance both to weights and measures officials throughout the United States and to packagers of products and commodities—the development of means by which uniformity in requirements pertaining to package labeling might be realized among all Federal and State authorities.

To this end, the Committee met in Washington on May 10 with representatives of six agencies of the Federal Government. During that meeting, the model package labeling requirements of the National Conference were discussed in detail, and the Federal officials individually explained their requirements and any inconsistencies between those and the model requirements.

Excellent lines of communication were developed. The Federal officials, without exception, dedicated themselves to the success of the Committee's aim.

Subsequent to that meeting, communications among Committee members have continued and the beginning of real progress can be seen.

The Committee has been kept informed of developments in the Congress of the United States relating to a Fair Packaging and Labeling Act. During its open meeting this matter was brought up from the floor and was discussed briefly.

This subject was determined to be the responsibility of the Resolutions Committee. Accordingly, the Committee has no recommendation to make.

During its open meeting on Monday the Committee encouraged weights and measures officials and representatives of business and industry to bring before it items deserving attention. It is the aim of the Committee to serve the Conference, all levels of Government, and business and industrial interests affected by or interested in weights and measures supervision.

It is the view of the Committee that its establishment by the Conference was an excellent and progressive move. It is the aim of the

present members to make every effort to see to it that the needs of the Conference in Federal-State relationships are well attended to.

A. L. Little, *Chairman*
K. C. Allen
R. J. Fahey
C. E. Joyce
F. W. Love
M. W. Jensen, *Secretary*
Committee on Liaison with the
National Government

(On motion of the Committee Chairman, seconded from the floor, the report of the Committee on Liaison with the National Government was unanimously accepted by voice vote.)

REPORT OF THE COMMITTEE ON LAWS AND REGULATIONS

Presented by L. Barker, *Chairman, Commissioner, Department of Labor, State of West Virginia*

(Thursday, July 14, 1966, 2:42 p.m.)

The Committee on Laws and Regulations submits its report to the 51st National Conference on Weights and Measures. The report consists of the Revised Tentative Report distributed at the Registration Desk of this Conference as amended by the Final Report.

1. MODEL STATE LAW ON WEIGHTS AND MEASURES

In order that the Model Law may be entirely correct with respect to State standards, particularly in light of the program of the National Bureau of Standards to provide new standards to each State, amendments to Sections 4 and 5 are deemed advisable.

SECTION 4. STATE STANDARDS OF WEIGHT AND MEASURE.—Amend by deleting the last sentence of the section.

SECTION 5. OFFICE AND WORKING STANDARDS AND EQUIPMENT.—Amend both the title and language to read:

SEC. 5. *FIELD STANDARDS AND EQUIPMENT.*—In addition to the State standards provided for in Section 4 of this Act, there shall be supplied by the State such "field standards" and such equipment as may be found necessary to carry out the provisions of this Act. The field standards shall be verified upon their initial receipt and at least once each year thereafter by comparison with the State standards.

SECTION 34. BUTTER, OLEOMARGARINE, AND MARGARINE.—The Committee has been informed that oleomargarine and margarine in liquid form are being test-marketed in several locations and that the Federal Food and Drug Administration has issued a definition and standard of identity for these products. The Model Law specifies that butter, oleomargarine, and margarine "shall be offered and exposed for sale and sold by weight, and only in units of ¼ pound, ½ pound, 1 pound, or multiples of 1 pound, avoirdupois weight."

It is the view of the Committee that an entirely proper interpretation of Section 34 would be that *the terms "butter, oleomargarine, and*

margarine" include these commodities whether in liquid or solid form and, accordingly, that the products, whether liquid or solid, must be offered and exposed for sale and sold by weight and only in the units specified in Section 34.

SECTION 38. HEATING AND COOKING OIL.—The title of this section has caused some confusion. The Committee recommends that this section be amended as follows:

SEC. 38. ***FURNACE AND STOVE OIL.*—All furnace and stove oil shall be sold by liquid measure or by net weight in accordance with the provisions of Section 25 of this Act. In the case of each delivery of such liquid fuel not in package form . . .**

SECTION 39. TEXTILE PRODUCTS.—Subsection (2) of this section permits the use of a "trademark, symbol, brand, or other mark that positively identifies such manufacturer, packer, or distributor" in lieu of the name and place of business of the manufacturer, packer, or distributor for textile products. It has been pointed out that the silence of the Model Law with respect to a method for "postively identifying" the responsible party is a void that should be corrected. The Committee, therefore, recommends that subsection (2) of Section 39 be amended by adding the sentence:

Any such trademark, symbol, brand, or other mark that is employed to identify the manufacturer, packer, or distributor shall be filed with the director.

SECTIONS 9, 24, and 44.—To provide for the promulgation of a Model Regulation Pertaining to the Voluntary Registration of Servicemen and Service Agencies for Commercial Weighing and Measuring Devices, three minor amendments to the Model State Law on Weights and Measures are necessary. The Committee recommends, therefore, the following amendments:

SECTION 9. SPECIFIC POWERS AND DUTIES OF DIRECTOR: REGULATIONS.—In line 10, delete the word "and"; change the period at the end of this to a comma and add the following regulation:

and (4) rules governing the voluntary registration of servicemen and service agencies.

SECTION 24. DUTY OF OWNERS OF INCORRECT APPARATUS.—At the end of the section, change the period to a semicolon and add the following phrase:

or until the rejection tag has been removed and the rejected device repaired and placed in service by a person duly registered to perform such acts under a regulation issued by the

director for the registration of weights and measures servicemen and service agencies.

SECTION 44. OFFENSES AND PENALTIES.—Amend subsection (2) to read as follows:

(2) Use, or have in possession for the purpose of current use for any commercial purpose specified in Section 11, a weight or measure that does not bear a seal or mark such as is specified in Section 15, unless such weight or measure has been exempted from testing by the provisions of Section 11 or by a regulation of the director issued under the authority of Section 9, or unless the device has been placed in service as provided by a regulation of the director issued under the authority of Section 9 of this Act.

(Item 1 was adopted by voice vote.)

2. MODEL STATE REGULATION PERTAINING TO PACKAGES

SECTION 1. APPLICATION.—The Committee has been asked to interpret the application of specific prominence and placement requirements to quantity declarations on small packages that, under the terms of Section 1, *APPLICATION*, are exempted from the requirements for such declarations. It is the opinion of the Committee that, *if a package is exempted from the requirement for a quantity declaration, stipulations as to a voluntarily presented quantity declaration are not imposed by the Model Regulation* and cannot be demanded under its terms.

Section 26 of the Model Law, [*METHOD OF SALE OF COMMODITIES*]: *PACKAGES: DECLARATIONS OF QUANTITY AND ORIGIN; VARIATIONS; EXEMPTIONS*, in subsection (c) under the second proviso, mandates the director to establish by regulation "exemptions as to commodities put up in variable weights or sizes for sale intact and either customarily not sold as individual units or customarily weighed or measured at time of sale to the consumer." There appears to be a definite omission in the Model Package Regulation, since this regulation makes no mention of any such exemptions. The Committee, therefore, recommends that Section 1, *APPLICATION*, of the Regulation be amended by adding at the end the following language:

***And Provided further,* That a commodity shall be exempt from such declaration if such commodity is put up in variable weights or sizes for sale intact and is customarily either weighed or measured at the time of sale to the consumer.**

SECTION 33. UNITS—WEIGHT, MEASURE.—This section requires, under (b), that declarations of liquid measure express the volume at 68°F (20°C) except for commodities normally sold while frozen or refrigerated, in which case the declaration expresses the

volume at the temperature normally prevailing when such commodity is sold. The "base" temperature for petroleum products is and has been 60°F; accordingly, the Committee deems it appropriate to amend Section 3.3.(b) to read as follows:

(b) in units of liquid measure shall be in terms of the United States gallon of 231 cubic inches or liquid-quart, liquid-pint, and fluid-ounce subdivisions of the gallon, and shall express the volume at 68°F (20°C), except in the case of petroleum products, for which the declaration shall express the volume at 60°F (15.6°C), and except also in the case of a commodity that is normally sold while frozen or refrigerated, for which the declaration shall express the volume at the temperature normally prevailing when such commodity is sold;

SECTION 6.7. [PROMINENCE AND PLACEMENT] PERMANENTLY LABELED GLASS CONTAINERS.—As this section is now written, it would apply to all glass containers on which label information is either blown or applied to the surface. This point must be clarified. Additionally, with the increasing use of plastics as containers, it is deemed by the Committee advisable to extend the coverage of Section 6.7. to plastics also, as appropriate. The Committee recommends that Sections 6.7., 6.7.1., 6.7.2., and 6.7.3. be amended to read as follows:

6.7. *PERMANENTLY LABELED GLASS OR PLASTIC CONTAINERS.*

6.7.1. *LABEL INFORMATION BLOWN, FORMED, OR MOLDED INTO SURFACE OF CONTAINERS.*—When all label information is blown, formed, or molded into the glass or plastic surface, the required declaration or declarations of quantity may also be blown or formed into the surface: *Provided,* That in such cases said declarations shall appear in close proximity to the trade or brand name; in the instance of glass or plastic containers for soft drinks or fruit juices, the height of any letter or number shall be not less than 3/16 inch for containers of 1 pint or less capacity and not less than 7/32 inch for containers of greater than 1 pint capacity; and for containers for all other products the minimum height of numbers and letters shall be as set forth in Section 6.5. of this regulation.

6.7.2. *LABEL INFORMATION APPLIED TO SURFACE OF CONTAINERS.*—When any label information is applied to the surface of a glass or plastic container in white or in any color, the required declaration or declarations of quantity shall also be applied to the surface. In the instance of glass or plastic containers for soft drinks or fruit juices, the height of any letter or number shall be not less than ⅛ inch for containers of 1 point or less capacity and not less than 3/6 inch for containers of greater than 1 pint capacity; and for containers for all other

products the minimum height of numbers and letters shall be as set forth in Section 6.5. of this regulation.

6.7.3. *LABEL INFORMATION ON CAP OR CROWN OF CONTAINERS.*—When all other label information is displayed on the cap or crown of a glass or plastic container, the required declaration of quantity may also be displayed on the cap or crown and shall be displayed prominently, conspicuously, and in color contrasting with the background: *Provided,* however, That in the instance of glass or plastic containers for soft drinks and fruit juices, and of plastic containers for milk and other fluid dairy products, when all other label information is displayed on the cap or crown, the required quantity declaration may be blown, formed, or molded into, or permanently applied to, that part of the glass or plastic container that is in close proximity to said cap or crown, in sizes as specified in Section 6.7.1.

SECTIONS 6.2., 6.3., 6.4.3., and 6.5.—To fulfill the aim described under Section 6.7., minor amendments to these sections will be necessary. The Committee, accordingly, recommends that each of these sections be amended by incorporating, as appropriate, references to plastic containers.

(Item 2 was adopted by voice vote.)

3. MODEL REGULATION FOR PAPER PRODUCTS

SECTION 5. GIFT WRAPPING PAPER.—Some confusion has arisen in connection with the application of this section to gift wrapping of all types offered for retail sale. To clarify, the Committee recommends that this section be amended to read as follows:

5. *GIFT WRAPPING.*—The declaration of quantity on a package of gift wrapping paper, foil, plastic, or other material, whether packaged as individual sheets or in roll form, shall indicate the numerical count and the dimensions of the individual sheets. The declaration of quantity on a package containing more than one roll ("multi-roll" packs) shall indicate the number of individual rolls and the dimensions of the sheet on each roll. Any linear dimension greater than 48 inches shall be expressed in terms of feet or as feet and inches. Any supplementary declaration of quantity shall be in juxta-position with, and shall be subordinate to, the required declaration.

(Item 3 was adopted by voice vote.)

4. MODEL REGULATION FOR ROOFING AND ROOFING MATERIALS

SECTION 1.—Since this regulation was not intended to cover roofing materials in liquid form, this should be made clear in the regula-

tion. The Committee recommends that the first sentence of Section 1 be amended to read as follows:

1. Roofing and roofing materials, except those in liquid form, shall be sold either by the "square" or by the "square foot."

(Item 4 was adopted by voice vote.)

5. MODEL REGULATION PERTAINING TO THE VOLUNTARY REGISTRATION OF SERVICEMEN AND SERVICE AGENCIES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES

There is evidence of increasing interest on the part of the States to establish controls of one kind or another over individuals and agencies servicing commercial weighing and measuring devices. With no guidance from the National Conference on Weights and Measures and no model from which to work, wide diversity is growing among the States. There presently are in existence a number of different types of controls for servicemen—licensing with examinations, licensing without examinations, bonding, involuntary registration, and voluntary registration.

It thus seems important to the Committee that the Conference adopt a model plan and language necessary to implement such a plan. The plan proposed is simple with respect to both requirements and administration. It offers to a serviceman and to a service agency the privilege of registering voluntarily with the director of weights and measures and, having registered, the privileges of restoring rejected devices to service and of placing in service new or used devices.

Servicemen and service agencies are required to provide evidence, in the form of references and of competence, and to submit standards and testing equipment for examination and certification when registering, and at least biennially thereafter. A certificate of registration, including an assigned registration number, is issued to a registrant by the director of weights and measures. The director is authorized, for good cause and after careful investigation and consideration, to revoke a certification of registration without recourse.

A registrant is required to execute and sign a "Place in Service Report" for each device he restores to service or places in service, and to send the original of said report to the director.

In order to provide maximum effectiveness of the program and to reduce to a minimum legal obstacles to service across State lines, provision is made for reciprocity among States having similar voluntary registration policies—reciprocity in recognition of registered servicemen and agencies and of certification of standards and testing equipment.

This plan has been endorsed by both the Scale Manufacturers Association and the National Scale Mens' Association.

The Committee recommends the adoption of the Model Regulation Pertaining to the Voluntary Registration of Servicemen and Service Agencies for Commercial Weighing and Measuring Devices, as follows:

MODEL REGULATION PERTAINING TO THE VOLUNTARY REGISTRATION OF SERVICEMEN AND SERVICE AGENCIES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES

Pursuant to the authority vested in me as set forth in section ____of chapter____of the_____statutes of the State of_____ (cite section or sections authorizing promulgation of general regulations), I, _____, State Director of Weights and Measures, hereby adopt and promulgate the following regulations:

REGULATION NO.____

1. *DEFINITIONS.*

1.1. *COMMERCIAL WEIGHING AND MEASURING DEVICE.*—The term "commercial weighing and measuring device" shall be construed to include any weight or measure or weighing or measuring device commercially used or employed in establishing the size, quantity, extent, area, or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award, or in computing any basic charge or payment for services rendered on the basis of weight, or measure, and shall also include any accessory attached to or used in connection with a commercial weighing or measuring device when such accessory is so designed or installed that its operation affects, or may affect, the accuracy of the device.

1.2. *REGISTERED SERVICEMAN.*—The term "Registered Serviceman" shall be construced to mean any individual who for hire, award, commission, or any other payment of any kind, installs, services, repairs, or reconditions a commercial weighing or measuring device, and which voluntarily registers himself as such with the Director of Weights and Measures.

1.3. *REGISTERED SERVICE AGENCY.*—The term "Registered Service Agency" shall be construed to mean any agency, firm, company, or corporation which, for hire, award, commission, or any other payment of any kind, installs, services, repairs, or reconditions a commercial weighing or measuring device, and which voluntarily registers itself as such with the Director of Weights and Measures. Under agency registration, identification of individual servicemen shall not be required.

2. *POLICY.*—It shall be the policy of the Director of Weights and Measures, hereinafter referred to as "Director," to accept voluntary

registration of (a) an individual and (b) an agency that provides acceptable evidence that he or it is fully qualified to install, service, repair, or recondition a commercial weighing or measuring device; has a thorough working knowledge of all appropriate weights and measures laws, orders, rules, and regulations; and has possession of, or available for use, weights and measures standards and testing equipment appropriate in design and adequate in amount. (An employee of government shall not be eligible for registration.) This policy shall in no way preclude or limit the right and privilege of any qualified individual or agency not registered with the Director to install, service, repair, or recondition a commercial weighing or measuring device.

3. *RECIPROCITY.*—The Director may enter into an informal reciprocal agreement with any other State or States that has or have similar voluntary registration policies. Under such agreement, the Registered Servicemen and the Registered Service Agencies of the States party to the reciprocal agreement are granted full reciprocal authority, including reciprocal recognition of certification of standards and testing equipment, in all States party to such agreement.

4. *REGISTRATION FEE.*—There shall be charged by the Director an annual fee of $1.00 per Registered Serviceman and $5.00 per Registered Service Agency to cover costs of administering the plan. Said fee shall be paid to the Director at the time application for registration is made, and annually, during the month of January, thereafter.

5. *VOLUNTARY REGISTRATION.*—An individual or agency may apply for voluntary registration to service weiging devices or measuring devices on an application form supplied by the Director. Said form, duly signed and witnessed, shall include certification by the applicant that the individual or agency is fully qualified to install, service, repair, or recondition whatever devices for the service of which competence is being registered; has in possession, or available for use, all necessary testing equipment and standards; and has full knowledge of all appropriate weights and measures laws, orders, rules, and regulations. An applicant also shall submit appropiate evidence or references as to qualifications.

6. *CERTIFICATE OF REGISTRATION.*—Upon receipt and acceptance of a properly executed application form, the Director shall issue to the applicant a "Certificate of Registration," including an assigned registration number, which shall remain effective until either returned by the applicant or withdrawn by the Director.

7. *PRIVILEGES OF A VOLUNTARY REGISTRANT.*—A bearer of a Certificate of Registration shall have the authority to remove an official rejection tag or mark placed on a weighing or measuring device by the authority of the Director; place in service, until such time as an official examination can be made, a weighing or measuring

device that has been officially rejected; and place in service, until such time as an official examination can be made, a new or used weighing or measuring device.

8. *PLACED IN SERVICE REPORT.*—The Director shall furnish each Registered Serviceman and Registered Service Agency with a supply of report forms to be known as "Placed in Service Reports." Such a form shall be executed in triplicate, shall include the assigned registration number, and shall be signed by a Registered Serviceman or by a serviceman representing a Registered Agency for each rejected device restored to service and for each newly installed device placed in service. Within 24 hours after a device is restored to service, or placed in service, the original of the properly executed Placed in Service Report, together with any official rejection tag removed from the device, shall be mailed to the Director at _____ (address) _____. The duplicate copy of the report shall be handed to the owner or operator of the device, and the triplicate copy of the report shall be retained by the Registered Serviceman or Agency.

9. *STANDARDS AND TESTING EQUIPMENT.*—A Registered Serviceman and a Registered Service Agency shall submit, at least biennially to the Director, for his examination and certification, any standards and testing equipment that are used, or are to be used, in the performance of the service and testing functions with respect to weighing and measuring devices for which competence is registered. A Registered Serviceman or Agency shall not use in servicing commercial weighing or measuring devices any standards or testing equipment that have not been certified by the Director.

10. *REVOCATION OF CERTIFICATE OF REGISTRATION.*—The Director may, for good cause, after careful investigation and consideration, suspend or revoke a Certificate of Registration.

11. *PUBLICATION OF LISTS OF REGISTERED SERVICEMEN AND REGISTERED SERVICE AGENTS.*—The Director shall publish, from time to time as he deems appropriate, and may supply upon request, lists of Registered Servicemen and Registered Service Agencies.

(Item 5 was adopted by voice vote.)

Lawrence Barker, *Chairman*
J. Lyle Littlefield
Matt Jennings
H. L. Godforth
J. F. Lyles
M. W. Jensen, *Secretary*
Committee on Laws and Regulations.

(On motion by Mr. Barker, seconded from the floor the Conference by voice vote adopted the Report of the Committee on Laws and Regulations.)

REPORT OF THE COMMITTEE ON SPECIFICATIONS AND TOLERANCES

presented by G. L. Johnson, *Chairman, Director, Division of Weights and Measures, State of Kentucky*

(Thursday, July 14, 1966, 3:15 p.m.)

The Committee on Specifications and Tolerances submits its report to the 51st National Conference on Weights and Measures. The report consists of the Tentative Report, transmitted during April as part of the Conference Announcement, as amended by the Final Report.

The substantive recommendations take the form of proposed amendments to the codes of National Bureau of Standards Handbook 44, Third Edition, *Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices.*

1. GENERAL CODE

General application paragraph G–A.6. NONRETROACTIVE REQUIREMENTS.—The Technical Committee of the Scale Manufacturers Association has pointed out, quite properly, that a significant change in the effectiveness of nonretroactive requirements was brought about with the adoption of the new codes. Whereas the Second Edition of Handbook 44 stipulated that such requirements did not apply "to equipment that is in the State at the time of such promulgation, either in use or in the stocks of manufacturers of or dealers in such equipment," the revised requirement is that nonretroactive requirements are not enforceable with respect "to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or dealer in the State of the effective date."

From the standpoint of scale manufacturers, the critical difference is that a device not in conformance with a nonretroactive requirement could not be accepted in trade with the plan that it be resold for commercial use.

It is the view of the Committee that the new requirement is completely appropriate and is, as a matter of fact, necessary if devices not meeting the latest technical requirements are to be, little by little, "weeded out" and replaced with devices that conform in all regards to the latest technical requirements.

The Committee recommends no amendment to general application paragraph G–A.6.

DISCUSSION OF FOREGOING ITEM

MR. D. B. KENDALL: The chairman of the SMA Technical Committee made a presentation at the open meeting on Monday requesting either clarification or rewording of this requirement to correspond to the Second Edition of H–44. The S and T Committee has not seen fit to go along with that suggestion, but because of the newness of the Third Edition we propose to follow the progess in various State interpretations and, if necessary, make a presentation at the next Conference.

(The foregoing Committee item was adopted by voice vote.)

General tolerances paragraph G–T.1. ACCEPTANCE TOLERANCES.—Mr. Lyles of Virginia suggests that a subparagraph be added to this paragraph to read "(d) to equipment that has been returned to commercial service following reconditioning, overhauling, or adjustments and is being officially tested for the first time within 30 days after corrective service."

A requirement such as this would reinstate the provision that existed in the Handbook prior to 1963, except that the period during which acceptance tolerances would be applied would be reduced from 90 days to 30 days. At that time the Committee and the Conference were of the view that, on the one hand, a device owner or operator was, in effect, being penalized for good service operations directed to the maintenance of his equipment in acceptable operating condition, and, on the other hand, it was always difficult for the official to determine if and when reconditioning, overhauling, or adjustments had been made in order that the acceptance tolerances could be applied.

The Committee is of the firm belief that the present provisions of the handbook are appropriate and adequate, and recommends no amendment to this paragraph.

DISCUSSION OF FOREGOING ITEM

MR. W. A. KERLIN: I think there is a very serious loophole in paragraph G–T.1. This has been covered in all of the handbooks prior to 1963, with the exception that there was a 90-day proviso. I cannot help but agree with Mr. Lyles that it should still be covered. I would like to make a motion to amend the committee report to read:

(d) To equipment that has been returned to commercial service following reconditioning, overhauling, or adjustments, and is being officially tested for the first time within 30 days after corrective service.

(The foregoing item, as amended, was adopted by voice vote.)

DISCUSSION ON THE RECONSIDERATION OF THE FOREGOING ITEM

MR. K. C. ALLEN: I think the Conference has just made a mistake. On the motion of Mr. Kerlin, we did adopt paragraph (d), which

specifies the official testing of equipment returned to commercial service following reconditioning, overhauling, or adjustments. Now, reconditioning is a major item. It should meet acceptance tolerances. And overhauling is major. But I think the Committee has made a mistake when it says that acceptance tolerances must be met whenever a scale or a meter is adjusted. I would suggest that somebody make a motion that you reconsider this and take "or adjustments" out of that paragraph.

MR. M. W. JENSEN: I believe it would be necessary, before we start discussion, for someone who favored the motion to move for reconsideration.

MR. KERLIN: I move for reconsideration of G–T.1. I would like to amend the motion that I previously made by striking the words "or adjustments" so that the committee report would read:

(d) To equipment that is being officially tested for the first time within 30 days after major reconditioning or overhaul.

(Following further discussion, paragraph (d) as amended following reconsideration was adopted by voice vote.)

General user requirements paragraph G–UR.4.4. REPLACEMENT OF SECURITY SEAL.—In a communication to the Committee, Mr. R. W. Searles of Medina County, Ohio, suggests that the Committee consider an amendment to this paragraph that would require a distinctive marking on a security seal affixed to any mechanism for adjustment following service, repair, or replacement that requires mutilation or destruction of the official seal.

The Committee recommends no amendment to this paragraph, because the purpose is simply to impose in the operator of a device the responsibility of seeing that the adjusting mechanism on his device is appropriately sealed at all times. The responsibility both for the accuracy of the device and for the sealing of the adjusting mechanism resides in the owner or operator, and the identification of an individual who affixes a replacement seal is of no legal consequence.

(The foregoing item was adopted by voice vote.)

2. SCALE CODE

Specifications paragraph S.2.1.2. BALANCE BALL.—Mr. Daniell of the City of Detroit has recommended that this paragraph be amended so as to clearly provide that the zero-load balance on scales of reasonably high capacity be adjustable only through the use of a tool outside of, and entirely separate from, the zero-adjusting element. Additionally, the Committee has been informed that, in some jurisdictions, the present language is being interpreted as requiring the use of a tool. It is the opinion of the Committee that the ease and rapidity of zero-adjustment of large scales should be encouraged and that,

when such adjustment can be accomplished with a readily accessible knurled knob, a push-button, or even an automatic mechanism, accuracy in weighing is promoted.

DISCUSSION OF FOREGOING ITEM

Mr. C. O. Cottom: I would like to request that the Committee study this matter for another year to see if the requirements of Handbook 44 are completely adequate.

Mr. J. H. Lewis: I thoroughly agree that we should do everything we can to facilitate the balancing of large-capacity scales. Commercially, I see nothing wrong with having a knurled knob or any other means which will facilitate the accurate and ready balancing of a large-capacity scale. I suggest that we stay with the Committee recommendation.

Mr. D. E. Konsoer: My reason for supporting Mr. Cottom's position is that a large-capacity scale, such as a livestock scale, equipped with a balancing mechanism that could be easily adjusted could lead to the perpetration of fraud, in violation of paragraph G–S.2. The scale could be adjusted so as to be behind zero balance during a weighing, and immediately after the weighing could be returned to zero balance.

Mr. Cottom: Going back in history, with the hanging poises, we have been very careful to make it mandatory that no loose balancing material be used. This new mechanism on automatic-type scales allows an operator to change the balance condition easily in a fraudulent manner.

Mr. Johnson: I would say the Committee has clearly stated its position in its final report. A definite problem has developed on some of the newer type scales, and the Committee feels that, with this ease of adjustment, there will be a better chance of getting exact weight. In addition, if the owner of a scale is ever caught manipulating the balance, the facilitation of fraud paragraph of Handbook 44 can be called to his attention.

Mr. Jensen: I think perhaps I should clear the record with respect to the original reason for this amendment. It had to do with the rotation of the balance ball itself. I believe you will find in searching the records that that amendment became necessary because the rotatable balance ball tended to move itself during a weighing operation; it was not made necessary by the problem of fraud. Furthermore, I believe the scale experts present will tell you that the reason it is necessary to have material inside the hanging poise fixed, and not loose, is because, if the material is loose, it tends to shift and will definitely change the ratio of the weighbeam.

(The proposed amendment to the foregoing item was defeated by a standing vote, and the Committee recommendation was adopted by a standing vote.)

Specifications paragraph S.6. MARKING REQUIREMENTS and definition "nominal capacity."—Amendments are recommended by the Scale Manufacturers Association with the following explanation:

There appears to be a trend toward requiring net weight printing of loads on vehicles. We understand Virginia requires printed net weight tickets for fill and similar material in highway construction and the midwest weights and measures officials are considering requirements for printed net weight tickets for delivery of fertilizer and feed grains. For the latter application, if the weight of an empty truck or a partially filled truck can be offset, the net weight of the full or partial load can be printed. To meet these requirements, a tare bar would be required on a type registering beam scale or additional tare capacity would be required on an automatic indicating scale with printing device. In some cases the same scale might be used for net weighing or gross weighing. Such a scale would have indicating elements which add up to a capacity considerably greater than the owner would ever require.

The Committee, upon investigation, is of the opinion that this is an appropriate request and accordingly *recommends that a subsection (d) under paragraph S.6.1. be added to read as follows:*

(d) On any scale with a nominal capacity less than the sum of the reading elements.

This amendment requires an amendment to the definition of "nominal capacity" so it will read as follows:

nominal capacity. **The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2½ percent of the sum of the capacities of the remaining reading elements *or* (b) the capacity marked on the scale by the manufacturer, *whichever is less.* (See also nominal capacity, batching scale; nominal capacity, hopper scale.)**

(The foregoing item was adopted by voice vote.)

Notes paragraph N.1.4. TEST FOR SENSITIVENESS FOR NONAUTOMATIC-INDICATING SCALES.—The Scale Manufacturers Association notes:

Considering the fact that a beam scale equipped with a balance indicator and graduated chart is as easy to read as an automatic-indicating scale, subpargraphs (b) and (c) of this specification require considerably greater sensitivity for the beam scale with balance indicator than for the automatic-indicating scale. This difference in requirements could be eliminated if "whichever is greater" were changed to "whichever is less" where this statement appears in both paragraphs. We recommend that this change be made.

The Committee has been informed of no difficulty in connection with conformance with this requirement and has no evidence that difficulty is to be expected. Accordingly, *the Committee recommends no change.*

(The foregoing item was adopted by voice vote.)

Sensitivity requirements paragraph SR.2. GENERAL.—When this paragraph (which establishes as the basic sensitivity requirement for nonautomatic-indicating scales "the value of the minimum graduated interval on the weighbeam *or* 0.1 percent of the test load, *whichever is greater*") was developed, both the Scale Code Advisory Committee and the Committee on Specifications and Tolerances were aware that it offered distinct possibilities of technical inappropriateness.

Mr. Lyles of Virginia has recommended that the proposed amendment for this paragraph included in the Tentative Report be changed so as to make the SR on a nonautomatic-indicating scale with a nominal capacity of 1,000 pounds or less the value of the minimum graduated interval on the weighbeam.

As the Committee points out in its Tentative Report, it is recommending the restoration of the language contained in the Second Edition of the Handbook while it continues to study this matter. The Committee is of the opinion that a change according to Mr. Lyles' recommendation might tend to confuse the matter further, and thus *recommends that paragraph SR.2. be amended to read as follows*:

SR.2. GENERAL.—Except for vehicle, axle-load, livestock, animal, railway track, prescription, jewelers, cream-test, and moisture-test scales, the SR on a nonautomatic-indicating scale shall be twice the value of the minimum graduated interval on the weighbeam, 0.2 percent of the nominal capacity of the scale, *or* 40 pounds, *whichever is least.*

(The foregoing item was adopted by voice vote.)

Tolerances paragraph T.2.2. [MINIMUM TOLERANCE VALUES] FOR LIVESTOCK SCALES.—This requirement, which fixes 2 pounds as the minimum tolerance value, maintenance and acceptance, for livestock scales, has been found to be unrealistics with respect to automatic-indicating scales with digital recording. Even

with the addition of one-half the value of the minimum graduated interval, as provided in tolerances paragraph T.1.2. for digital indicaitons or representations, a digital scale with 5-pound intervals would be permitted to print no error from zero to 2,500 pounds on acceptance test, and from zero to 1,250 pounds on maintenance test.

The Committee recommends that tolerances paragraph T.2.2. be amended to read as follows:

T.2.2. FOR LIVESTOCK SCALES.—The minimum maintenance tolerance and acceptance tolerance shall be 2 pounds, *or* one-half the value of the minimum graduated interval, *whichever is greater.*

(The foregoing item was adopted by voice vote.)

Tolerances paragraph T.2.5. [*MINIMUM TOLERANCE VALUES*] *FOR RAILWAY TRACK SCALES.*—The present requirement for a minimum tolerance value of 25 pounds for a railway track scale is technicially incorrect in light of a minimum test-weight load of 30,000 pounds and a basic acceptance tolerance of 1 pound per 1,000 pounds of test load.

The Committee recommends that tolerance paragraph T.2.5. be amended by replacing "25 pounds" with "30 pounds."

(The foregoing item was adopted by voice vote.)

TOLERANCES FOR SCALES IN GRAIN WEIGHING SERVICE.—Mr. H. W. Ritter of the Terminal Grain Weighmasters National Association, Chicago, addressed a letter to the Conference and stated that his organization found the provisions of the Scale Code "objectionable" because they did not recognize the existence of a 1920 Interstate Commerce Commission Docket (9009) which proposed tolerances for scales in grain weighing service somewhat less than those presented in the Handbook.

In its return communication, the Committee pointed out to Mr. Ritter that ICC Docket 9009 has no legal status, "and since many other commodities of greater value per pound are shipped in quantity interstate, it was the decision of the Committee, backed up by Conference adoption, to include grain scales with scales used to weigh all other commodities."

The Committee is confident that the position taken by the Conference in this regard is sound and that this matter requires no further review.

(The foregoing item was adopted by voice vote.)

User requirements paragraph UR.1.1.6. [*VALUE OF MINUMUM GRADUATED INTERVALS ON PRIMARY INDICATING AND RECORDING ELEMENTS*] *FOR VEHICLE SCALES.*

AXLE-LOAD SCALES, AND WHEEL-LOAD WEIGHERS ONLY.—Once again the scale manufacturers have recommended that there be no specified minimum graduated interval for axle-load scales, which, under the terms of application paragraph A.2., are covered by the code only when they are "in official use for the enforcement of traffic and highway laws."

Although the Committee is well aware of the variations in force exerted by a single axle of a multiple-axle highway unit, and is aware also that the weight determination of such a single axle is never a precise reflection of the forces that may be exerted by that axle on the highway, the Committee cannot ignore the response of weights and measures officials to the questionnaire distributed to all States during the development of the Handbook revision. At that time, it was the overwhelming consensus of State highway load-limit enforcement officials that a 20-pound graduation was desired (even, in some cases, required) on axle-load scales.

The Committee recommends no amendment to user requirement UR.1.1.6.

(The foregoing item was adopted by voice vote.)

Definition "decreasing-load test."—With the stipulation in notes paragraph N.1.2. that the decreasing-load test on an automatic-indicating scale be conducted with a test load equal to one-half of the maximum applied test load, the present definition for decreasing-load test is incorrect.

The Committee recommends that this definition be amended to read as follows:

decreasing-load test. **A special supplementary test for automatic-indicating scales only, during which the performance of the scale is tested when the load is being reduced. In this test, an observation is made with a test weight load equal to one-half of the maximum applied test load.**

Definition "sensitivity requirements (SR)."—Under the new meaning of SR (sensitivity requirement), the definition may be subject to misinterpretation.

Accordingly, the Committee recommends that this definition be amended to read as follows:

Sensitivity requirement (SR). **A performance requirement for a nonautomatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount, of the test-weight load on the load-receiving element of the scale.**

(The foregoing definitions were adopted by voice vote.)

Specifications paragraph S.1.4.4. PRINTED TICKETS.—During the open meeting, gas pump manufacturers recommended that this paragraph, which presently requires that a ticket issued by a retail device that presents the total computed price shall present also the total volume of the delivery in terms of gallons and the price per gallon, be amended to permit the total price and either the total volume or the price per gallon. In their presentation, industry representatives claimed that devices to meet the present requirement are not available, but that devices to meet the requirement recommended by them are available. As the Committee pointed out last year, it does not desire to inhibit technical progress; nonetheless, the issuance of a ticket by a computing weighing or measuring device that does not include the quantity delivered and the price per unit of weight or measure is definitely lacking with respect to present-day requirements. Additionally, the Committee must point out that no device such as is claimed to be in existence has been demonstrated to any of its members. *No amendment is recommended.*

(The foregoing Committee item was adopted by voice vote.)

TOLERANCES—DIGITAL INDICATIONS OR REPRESENTATIONS.—An industry spokesman has recommended that recognition be given to digital indications and representations of retail liquid-measuring devices and that a tolerance paragraph be added to provide an additional tolerance equal to one-half of the minimum value that can be indicated or recorded. This would in effect recognize, as presently is done in the Scale Code, the inability of digital indicators or recorders to decide whether to go up or down in indicating or recording when the actual delivery is precisely half way between two values that can be indicated or recorded. The Committee has seen no evidence of retail liquid-measuring devices that are truly digitial, and, until such time as these devices are at least "on the drawing board" cannot conscientiously recommend an alteration in the code. *No amendment is recommended.*

(The foregoing item was adopted by voice vote.)

4. CODES FOR LIQUID-MEASURING DEVICES AND VEHICLE-TANK METERS

TOLERANCES.—During recent years, and particularly in connection with the preparation of the revision of the codes, many weights and measures officials have recommended that the tolerances on wholesale liquid-measuring devices and on vehicle-tank meters be reduced for large test drafts. (The Southern Weights and Measures Association, in conference on October 20, 1965, adopted a recommendation of its Committee on Specifications and Tolerances: "We recommend to

the Specifications and Tolerances Committee of the National Conference on Weights and Measures, the meter manufacturers, and the American Petroleum Institute that they increase their efforts in studying present tolerances on wholesale meters in order to be in position to recommend to the 51st National Conference reduced tolerances on wholesale-type meters.")

Subsequent to the publication of the Tentative Report, the Committee received a communication from Mr. R. C. Primley, Chairman of the API Subcommittee on Weights and Measures:

The American Petroleum Institute is happy to report, that under the direction of the Operation and Engineering Committee, its Subcommittee of Weights and Measures was given authority, and have set up a Technical Committee to work with the National Conference and the National Bureau of Standards in the determining of adequate tolerance for petroleum meters in the area of wholesale marketing. More recently, approval has been given to employ a full time technical director with the experience and knowledge to establish a research and fact finding program and work in conjunction with the National Bureau of Standards in this endeavor. With the work of the Technical Committee, and the full time director, we feel you can be assured that by the 52nd Conference in 1967, sufficient information will have been developed to help all concerned make a satisfactory constructive decision.

The Chairman of the Meter Manufacturers' Technical Committee has recommended a special "special" tolerance for a split compartment test of a vehicle-tank meter—a tolerance based upon the flow rate of the meter under test. The meter manufacturers point out, and accurately, that the error developed during a split-compartment test (designed to test the effectiveness of the meter air separator) is a function of the compartment, piping, and meter design, and is not normally affected by the volume of the test draft.

The tolerances "on special tests" set forth in tolerance paragraph T.2. and Table 1 were developed to include tests specified under notes paragraph N.4.2. SPECIAL TESTS, including those designed "to develop operating characteristics of the metering system during a split-compartment delivery." The Committee has no evidence of unreasonable numbers of meters being rejected as a result of split-compartment tests and no information from weights and measuures officials as to hardships being thus created.

The Committee recommends no amendment.

(The foregoing item was adopted by the conference.)

5. CODE FOR VEHICLE-TANK METERS

PRESSURE CONTROL.—The City of New York has recommended that a UR installation paragraph be added that would require

that the "installed" pressure of the product in a meter be not greater than the "rated" pressure. In his communication, Mr. Richard W. Brevoort, Director, New York City Bureau of Weights and Measures, points out that his inspectors have found many faulty air eliminators with collapsed floats, apparently caused by very high pump pressures.

The Committee is of the opinion that this matter is adequately covered by general user requirements paragraph G–UR.2.1. INSTALLATION, wherein it is stipulated that a device shall be installed in accordance with the manufacturer's instructions. Accordingly, *no action on this matter is recommended.*

(The foregoing item was adopted by voice vote)

6. CODE FOR VEHICLE TANKS USED AS MEASURES

COMPARTMENT INDICATORS, CALIBRATION CHARTS, AND MEASURING STICKS.—A recommendation that the Code for Vehicle Tanks be Used as Measures be amended has been received by the Committee from the City of New York. This recommendation includes two proposed amendments—(1) a specification requirement that there be a suitable indicator in a compartment, and (2) that a compartment be supplied with a calibration chart and measuring stick.

Historically, only vehicle tanks with indicators have been classified as vehicle tanks used as measures. Throughout the years it has not been deemed necessary by the Conference or by the States to include a requirement that indicators be a part of the tank. (Many specification requirements with respect to the indicators themselves are, of course, included in the code.)

During a rather long period of time, measuring sticks (which became known in the trade as "guessing sticks") were accepted in the measure of partial compartment deliveries of petroleum products. With the wide use of liquid meters mounted on vehicle tanks, the Conference and the States prohibited the use in commercial delivery of the measuring stick. The Committee is of the opinion that official recognition of this type of measurement would be retrogression.

The Committee recommends no amendment to the Code for Vehicle Tanks Used as Measures.

(The foregoing item was adopted by voice vote.)

7. METERING OF CRYOGENIC FLUIDS

The Compressed Gas Association of New York City has been in communication with the Committee Secretary in connection with the development of a code for cryogenic liquids including, but not limited to, liquid argon, liquid helium, liquid hydrogen, liquid methane, liquid nitrogen, and liquid oxygen at temperatures below −150° C (−238° F).

Mr. Gordon N. Stropel, Assistant Secretary of the Association, has advised that a Subcommittee on Weights and Measures of Cryogenic Fluids has been formed and has been working toward the development of appropriate code material.

The Committee is not aware of the extent to which cryogenic fluids are metered commercially. If it is determined that such measurement is of sufficient consequence to warrant the development of code material, the Committee will direct its attention along these lines. Advice on this point is solicited from the States.

(The foregoing item was adopted by voice vote.)

8. CODE FOR MILK BOTTLES

Specifications paragraph S.4. MARKING REQUIREMENTS.— In its report to the 50th National Conference, the Committee noted that, in its view, tolerances on milk bottles were in need of consideration and that bottle manufacturers and the trade organization representing dairies had requested time to conduct a comprehensive study. This study now has been completed and a recommendation with respect to milk bottle tolerances has been received.

It will be noted that, in the proposal, tolerances are unbalanced—greater in excess than in deficiency. The aim here is to provide, on the average, milk bottles that will contain at least the nominal volume. Although the proposed tolerances are not presented as nonretroactive, the Committee recommends that they become effective only with respect to milk bottles that are manufactured after adoption of the new tolerances by the Conference. To facilitate the implementation of these new tolerance requirements with respect to milk bottles manufactured after the effective date, the Committee recommends that they be identified and that such identification be uniform among all bottles.

Th weights and measures heads of the northeastern States, meeting at Hartford, Connecticut, May 18 and 19, suggested that the Committee give consideration to alternative language for specifications paragraph S.4., reading as follows: "S.4. MARKING REQUIREMENTS.—A milk bottle shall be permanently marked with a statement of its capacity. The capacity statement shall appear on the breast of the bottle near the junction of the shoulder and neck."

The Committee recommends no action on this proposal because it can see no purpose that would be served and because millions of bottles now in use and thousands of molds for the making of bottles have the capacity marking in other and apparently fully satisfactory locations.

Following the issuance of its tentative report, the Committee received a communication from Mr. Earl Wagner of the Glass Container Manufacturers Institute pointing out, quite appropriately, that the proposed nonretroactive language suggested for a new specifica-

tions paragraph S.4.2. IDENTIFICATION was unrealistic in that it stipulated an effective date of July 1, 1966 (actually before Conference action) and required that the date marking on a milk bottle be in "close proximity to the capacity marking." (Milk bottles are marked as to date, but the marking normally is on the bottom.)

The Committee recommends that specifications paragraph S.4. be amended to read as follows:

S.4. MARKING REQUIREMENTS.

S.4.1. CAPACITY.—A milk bottle shall be permanently marked with a statement of its capacity. The capacity statement shall not be on the bottom of the bottle.

S.4.2. IDENTIFICATION.—*A milk bottle manufactured after January 1, 1967, shall be marked with the last two digits of the year in which the bottle was manufactured.*

TOLERANCES ON AVERAGE CAPACITY AND ON INDIVIDUAL BOTTLE. Amend Table 1 and paragraph T.2., and add Table 2, to read as follows:

T.1. TOLERANCE ON AVERAGE CAPACITY.—Maintenance and acceptance tolerances in excess and in deficiency on the average capacity of milk bottles tested shall be as shown in table 1.

TABLE 1.—*Maintenance and acceptance tolerances, in excess and in deficiency, on average capacity of milk bottles*

Nominal capacity	Tolerances on average capacity			
	In excess		In deficiency	
	Fluid drams	Cubic inches	Fluid drams	Cubic inches
10 fluid ounces or less	0.75	0.17	0.25	0.06
1 pint	1.00	0.23	0.50	0.11
1 quart	1.25	0.28	0.75	0.17
½ gallon	2.00	0.45	1.00	0.23
1 gallon	3.00	0.68	2.00	0.45
2 gallons	6.00	1.35	3.00	0.68

T.2. TOLERANCE ON INDIVIDUAL BOTTLE.—Maintenance and acceptance tolerances in excess and in deficiency on the capacity of an individual milk bottle shall be as shown in table 2.

TABLE 2.—*Maintenance and acceptance tolerances, in excess and in deficiency, on capacity of an individual milk bottle*

Nominal capacity	Tolerances on individual capacity			
	In excess		In deficiency	
	Fluid drams	Cubic inches	Fluid drams	Cubic inches
10 fluid ounces or less	2.25	0.50	1.25	0.28
1 pint	3.00	0.68	2.00	0.45
1 quart	4.00	0.90	3.00	0.68
½ gallon	6.00	1.35	5.00	1.13
1 gallon	10.00	2.26	8.00	1.80
2 gallons	18.00	4.06	12.00	2.71

It must be pointed out that, since tolerances can never be nonretroactive, weights and measures officials will be required to exercise particularly good judgment with respect to the enforcement of these new provisions of the Milk Bottle Code. First, every State should take immediate action to give official status to the new provisions in order that bottle manufacturers may modify their molds without delay and start supplying bottles according to the new requirement as of January 1, 1967. Second, examinations of bottles on hand but not yet placed in service should be completed prior to January 1, 1967, in order that bottles purchased and manufactured according to the old requirements, and in completely good faith, can be approved for service without hazard.

Uniformity on this point is a particular obligation of all weights and measures administrators.

(Item 8, code for milk bottles, was adopted by voice vote.)

9. CODE FOR ODOMETERS

The Committee has been working with the automobile industry toward the standardization of odometers on trucks, the primary concern being, of course, trucks rented on the basis of mileage. This turns out to be rather a tremendous task. There are literally tens of thousands of transmission-differential-tire combinations in use in the trucking industry, and detailed tests and studies must be made to design the most accurate odometer.

The Committee is assured that, with the vehicle-year 1968 trucks, odometers on so-called light trucks (10,000 pounds gross vehicle weight and less) will meet specifications, and that the medium and heavy trucks will follow shortly.

The Committee's recommendations to weights and measures officials are (1) that no regular testing program of truck odometers be conducted until they are specifically included in the code and (2) that a complaint be handled on an individual basis with such adjustment of charges as is indicated by the particular case.

(The foregoing item was adopted by voice vote.)

The Committee is gratified by the response of the States in giving official status to the new Handbook. There remains, however, a number of States that have not yet taken action. It is the sincere hope of the Committee, and of all conscientious weights and measures officials, that the remaining States will take this necessary step in the very near future.

The principal aim of this Conference is uniformity. Surely uniformity in technical requirements for devices—requirements developed democratically through the Conference—should be a first effort of every State.

G. L. Johnson, *Chairman*
H. J. McDade
J. F. McCarthy
H. D. Robinson
C. H. Stender
M. W. Jensen, *Secretary*
Committee on Specifications and Tolerances

(Mr. Johnson moved for adoption and, after a second from the floor, the Report of the Conference Committee on Specifications and Tolerances, as amended, was adopted by the Conference by voice vote.)

REPORT OF THE COMMITTEE ON NOMINATIONS

presented by R. Williams, *Chairman, County Sealer of Weights and Measures, Nassau County, New York*

(Thursday, July 14, 1966, 3:10 p.m.)

As provided in the Organization and Procedure of the Conference, the Director of the National Bureau of Standards, Dr. A. V. Astin, is the President of the Conference and is authorized to designate the Executive Secretary. All other officers are to be elected by vote of the Conference with the exception that vacancies occurring during the Conference year may be filled by the Executive Committee.

In selecting active members of the Conference to nominate for elective officers as presented in this report, consideration was given by the Committee to several factors, such as attendance records, geographical distribution, Conference participation, and interest shown in promoting Weights and Measures Administration.

The Nominating Committee submits the following report, nominating for office for the National Conference on Weights and Measures and to serve for the ensuing year or until their successors might be elected, the following:

Chairman: J. E. Bowen, Massachusetts.

Vice Chairman: C. O. Cotton, Michigan; R. H. Fernsten, California; F. M. Gersz, Connecticut: J. G. Gustafson, Minnesota.

Treasurer: C. C. Morgan, Indiana.

Chaplain: R. W. Searles, Ohio.

Executive Committee: J. R. Bird, New Jersey; S. J. Darsey, Florida; R. J. Fahey, Illionis; I. R. Frazer, Indiana; M. Greenspan, New York; W. H. Holt, West Virginia; D. E. Konsoer, Wisconsin; J. H. Lewis, Washington; W. A. Polaski, Pennsylvania; J. D. Walton, Texas.

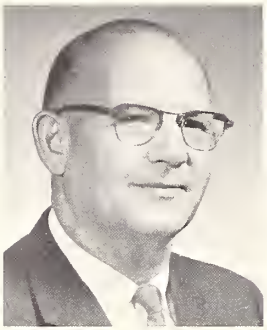
R. Williams, *Chairman*
E. H. Black
V. D. Campbell
H. E. Crawford
J. B. McGee
R. E. Meek
D. M. Turnbull
Committee on Nominations

(There being no further nominations from the floor, nominations were declared closed and the officers nominated by the Committee were elected unanimously by voice vote.)

REPORT OF THE COMMITTEE ON RESOLUTIONS

presented by E. W. Ballentine, *Chairman, Director, Bureau of Inspection, State of South Carolina*

(Friday, July 15, 1966, 9:40 a.m.)



The Committee on Resolutions, having met and considered resolutions submitted to it by members of this 51st National Conference on Weights and Measures and other resolutions that originated with members of the Committee, now submits to this Conference for its consideration and action the following resolutions that have received the unanimous endorsement of the Committee.

There are included a number of individual resolutions which express appreciation for the arrangements for, conduct of, and participation in the National Conference. In order to expedite the handling of this phase of the Conference program, I request permission of the Chair simply to indicate those to whom appreciation is to be officially expressed:

1. To the Honorable John P. Orcutt, Commissioner of Agriculture, State of Colorado, for his constructive contribution to the program of the 51st National Conference on Weights and Measures.

2. To. Dr. A. V. Astin, J. P. Eberhard, M. W. Jensen, and staff of the National Bureau of Standards for their tireless efforts to insure a successful Conference in planning and administering the program and other details so essential to an interesting educational meeting.

3. To Mr. C. L. Bragaw and the staff of the Boulder Laboratories, National Bureau of Standards, for the many details involved in the physical arrangements of the Conference.

4. To the National Association of State Departments of Agriculture for the interest and contributions in obtaining these new basic standards for greater accuracy in quality determination.

5. To the National Park Service for making available the services of Mr. Glen D. Gallison, and to Mr. Gallison for the many courtesies extended to the Conference delegates.

6. To all program speakers and Standing Committees for their excellent presentations and contributions to the success of the Conference.

7. To all State and local governing agencies that have arranged for or made possible the attendance at this meeting of one or more representatives of their organizations to participate in the deliberations directed toward the betterment of weights and measures controls throughout the Nation.

8. To business and industry for cooperating with the Conference, for attending and participating in the Conference, and for contributing to the success of the Conference through their participation and their gracious hospitality.

9. To the Denver Convention and Visitors Bureau for assisting with the registration of delegates, for making available the use of bulletin typewriters, and for furnishing such excellent materials for distribution to the delegates.

10. To the management of The Brown Palace Hotel, who, through the facilities and courtesies of its staff, has materially assisted in the conduct of the conference.

The following resolutions are being read in whole in order that they might receive the consideration of the members of this Conference:

MOISTURE IN GRAIN

Whereas, it is recognized that there exists great confusion in the determination of moisture contents of grain being sold;

Therefore, be it resolved that this 51st National Conference on Weights and Measures recommend and request the U.S. Department of Agriculture and the U.S. Department of Commerce, National Bureau of Standards, to jointly study and develop uniform methods for determining moisture in grains being bought and sold. This said study to include methods of test and standards for moisture meters.

RESOLUTION ON FAIR PACKAGING AND LABELING LEGISLATION

Whereas, the National Conference on Weights and Measures has long provided leadership in a cooperative State-Federal-industry effort for nationwide uniformity in requirements for packaging and labeling of commodities in the interest of consumers; and

Whereas, under the leadership of the National Conference on Weights and Measures, a majority of the States have adopted similar laws and regulations in the cause of uniformity, and many industries, at great expense, have complied with these laws and regulations, especially as they apply to labeling; and

Whereas, in 1963, the 48th National Conference adopted a resolution of appreciation for congressional interest in "Truth in Packaging" legislation; and

Whereas, U.S. Senate Bill S. 985, "Fair Packaging and Labeling," as reported favorably by the Senate Committee on Commerce in May 1966 and subsequently passed by the Senate, in general is consistent with the aims and efforts of this Conference: Therefore, be it

Resolved, That this 51st National Conference on Weights and Measures, duly assembled in Denver, Colorado, this 15th of July 1966, hereby endorses legislation on fair packaging and labeling to attain the goals parallel with this Conference; and be it further

Resolved, That this Conference endorses enactment by the Congress of S. 985 as passed by the Senate, but recommends, in order to facilitate the accomplishment of the bill's objectives, certain technical language changes, as follows:

1. Section 12, pertaining to the bill's effect on State law, should be clarified to reflect the view of the Senate Committee on Commerce,

as published in the Report of the Committee, that "the bill is not intended to limit the authority of the States to establish such packaging and labeling standards as they deem necessary in response to State and local needs." Specifically, the Conference recommends the substitution of the words "are inconsistent or in conflict with" for "differ from" in said Section 12. This would make absolutely clear that State consumer-oriented weights and measures laws are not nullified, whether differing or not from Federal laws or regulations, if these are necessary for the protection of the citizens of the State and do not conflict with Federal laws or regulations so as unreasonably to affect the flow of products in interstate commerce.

2. The requirements for the declaration of net quantity of contents on the label under Section 4(a)(3)(A) should be expressed in terms of the largest whole unit or decimal fraction thereof, rather than being restricted to ounces or whole units of pounds, pints, or quarts. Declarations of quantities of length, area, and numerical count should be included in such requirements.

3. Since the words "accurately stated" in Section 4(a)(2) could be construed under present custom and usage to allow no measurement inaccuracy whatsoever, the Conference recommends adding the phrase "as is consistent with good packaging practice" after the words "accurately stated."

4. The parenthetical expression in Section 4(a)(3)(B), "(by typography, layout, color, embossing, or molding)," should be deleted, since the three critical points with respect to conspicuousness are type size, color contrast, and free surrounding area.

and be it further

Resolved, That copies of this resolution be transmitted to the appropriate committee or committees of Congress and to the Secretary of Commerce.

E. W. Ballentine, *Chairman*
G. L. Delano
R. H. Fernsten
B. S. Cichowicz
D. E. Konsoer
W. A. Polaski
R. K. Slough
Committee on Resolutions

(On motion of the Committee Chairman, seconded from the floor, the Report of the Committee on Resolutions was adopted by voice vote.)

REPORT OF AUDITING COMMITTEE

presented by N. P. Tilleman, *Chairman, City Sealer of Weights and Measures, Green Bay, Wisconsin*

(Friday, July 15, 1966, 9:50 a.m.)

The Auditing Committee met on the morning of July 13 and inspected the financial statements of the Conference Treasurer, Mr. C. C. Morgan. We found them in good order.

N. P. Tilleman, *Chairman*
H. N. Duff
I. R. Frazer

Committee on Auditing

(The report of the Auditing Committee was adopted by voice vote.)

REPORT OF THE TREASURER

presented by C. C. Morgan, *Treasurer, City Sealer of Weights and Measures, Gary, Indiana*

(Friday, July 15, 1966, 9:53 a.m.)

Balance on hand June 1, 1965		$6,770.87
Receipts:		
Registration fees—589 at $15.00	$8,835.00	
Refund from Education Committee	17.00	
Trade Party	1,030.00	
Sale of Banquet Tickets—16 at $10.00	160.00	
Ladies Luncheon	225.00	
Weights and Measures Exposition	4,444.49	
Bank Interest Accrued	270.85	
Subtotal	14,982.34	14,982.34
Total		21,753,21
Disbursements:		
Lamb Seal & Stencil Company	37.74	
Franklin Press, Receipts, Tickets, and I. D. Cards	151.80	
T. M. Stabler, Entertainment	175.00	
Stephen Lesieurs Music	490.00	
The Film Center	59.00	
Washington Country Club, Ladies Buffet	247.50	
The Chesapeake & Potomac Telephone Company	14.46	
The Chesapeake & Potomac Telephone Company	13.47	
Franklin Press, Brochure, Program, and Badges	228.60	
A. B. & W. Transit Co., Sightseeing	144.00	
Exhibits Aids	248.00	
Virginia Moore, Fashion Lecture, Ladies	35.00	
Sheraton Hotel, Dinner, Breakfasts, Florentine and Balcony, Cotillion Room	9,466.30	

DISBURSEMENTS—Continued

The American Electrotype Company, Mats	$35.00	
Lamb Seal & Stencil Company	7.00	
William Stancliff, Attendance Certificates	28.30	
Franklin Press, Identification Cards and Receipts	83.10	
Hotel for Mr. Owen, Ladies Luncheon on Tour, Banquet Miscellaneous, Headquarters Suite, and Registration Desk	553.95	
Bank Charge	8.10	
Subtotal	12,026.32	$12,026.32
Total balance on hand June 10, 1966		9,726.89

DEPOSITORY:

Bank of Indiana, Gary, Indiana

First Federal Savings and Loan Company, Gary, Indiana

(Signed) C. C. MORGAN.

(On motion of the Treasurer, seconded from the floor, the Report of the Treasurer was adopted by the Conference.)

PERSONS ATTENDING THE CONFERENCE

Delegates—State, City, and County Officials

ARIZONA

City Sealer of Weights and Measures:

Phoenix 85003—— S. E. Favour, Division of Licenses, Municipal Office Building, 10 N. 3d Avenue.

ARKANSAS

State—— A. L. Little, Director Divison of Weights and Measures, State Plant Board, 421½ W. Capitol Avenue. Box 1069, Little Rock 72203.

CALIFORNIA

State—— W. A. Kerlin, Chief, Bureau of Weights and Measures, Department of Agriculture, 1220 N Street, Sacramento 95814.

County Sealers of Weights and Measures:

Alameda—— R. H. Fernsten, 333 5th Street, Oakland 94607.
Contra Costa—— A. B. Coon, County Department of Agriculture, 161 John Glenn Drive, Buchanan Airport, Concord 94520.
Kern—— A. D. Rose, 1116 E. California Avenue, Bakersfield 93307.
Los Angeles—— M. H. Becker, 3200 N. Main Street, Los Angeles 90031.
Marin—— K. B. Brown, 519 4th Street, San Rafael 94901.
Orange—— William Fitchen, 1010 S. Harbor Boulevard, Anaheim 92805.
San Bernardino—— H. E. Sandel, 160 E. 6th Street, San Bernardino 92410.
San Diego—— H. J. McDade, 1480 F Street, San Diego 92112.
San Luis Obispo—— B. G. Corrick, P.O. Box 637, San Luis Obispo 93401.
San Mateo—— H. E. Smith, 702 Chestnut Street, Redwood City 94063.
Santa Clara—— R. W. Horger, 409 Mathew Street, Santa Clara 95050.
Solano—— Stuart Burk, 560 Fairgrounds Drive, Vallejo 94590.
Sonoma—— E. J. Bologna, Room 407 County Administration Center, 2555 Mendocino Avenue, Santa Rosa 95401.
Stanislaus—— J. M. Abernethy, P.O. Box 2015, 2115 Scenic Drive, Modesto 95354.
Ventura—— E. H. Black, P.O. Box W—Main P.O.. Ventura 93002.

COLORADO

State——J. P. Orcutt, Commissioner, Department of Agriculture, State Services Building, 1525 Sherman Street, Denver 80203.
H. N. Duff, State Supervisor, Weights and Measures Section.
T. W. Singleton, Assistant.
W. M. Morrish, Administrative Assistant.
Inspectors:
C. S. Bentley.
C. C. Crouse

H. L. Gillispie.
G. D. Hooker.
Raleigh Messerschmitt.
Earl Prideaux.
C. M. Scofield.
T. J. Wark.
F. H. Brzoticky, Laboratory Technician.
Harvey Houston, Director, Oil Inspection Department, 1024 Speer Boulevard, Denver 80204.

City Sealer of Weights and Measures:

Denver 80202——H. E. Gardner, Room 202, 810 14th Street.
Andrew Kutes.

CONNECTICUT

State——F. M. Gersz, Deputy Commissioner, Department of Consumer Protection, Room 105 State Office Building, Hartford 06115.
J. T. Bennett, Chief, Weights and Measures Division.
W. B. Kelley, Senior Inspector.

City Sealers of Weights and Measures:

Hartford 06103——Nathan Kalechman, City Hall, 550 Main Street.
New Britain 06151——A. J. Albanese, City Hall.

DELAWARE

State——W. H. Naudain, Director, Department of Weights and Measures, State Board of Agriculture, Dover 19901.

FLORIDA

State——S. J. Darsey, Inspector of Weights and Measures, Division of Standards, Department of Agriculture, 1118 S. 17th Avenue, Hollywood 33020.

City Sealers of Weights and Measures:

Jacksonville 32202——H. E. Crawford, Room 203 City Hall.
H. E. Howard, P.O. Box 708
Miami 33133——Coconut Grove Station.

GEORGIA

State——J. B. McGee, Director, Weights and Measures Division Department of Agriculture, Agriculture Building, Capitol Square, Altanta 30334.

IDAHO

State——Lyman Holloway, Inspector, Weights and Measures Division, Department of Agriculture, P.O. Box 790, Boise 83701.

ILLINOIS

State—H. L. Goforth, Superintendent, Division of Feeds, Fertilizers, and Standards, Department of Agriculture, State Fairgrounds, 531 E. Sangamon Avenue, Springfield 62706.

City Sealers of Weights and Measures:

Chicago 60610—R. J. Fahey, Central Office Building Room 302, 320 N. Clark Street.
T. R. Heller, Inspector.
60605—Luke Prendergast, Chief Taximeter Inspector, Public Vehicle License Commission, 1111 S. State Street, Room 105.

INDIANA

State—R. E. Meek, Director, Division of Weights and Measures, State Board of Health, 1330 W. Michigan Street, Indianapolis 46207.
L. A. Gredy, Inspector.

County Inspectors of Weights and Measures:

Clark—R. W. Walker, Court House Annex, Jeffersonville 47130.
Floyd—E. G. Silver, Room 325 City-County Building, P.O. Box 362, New Albany 47150.
Grant—Harvey Cline, P.O. Box 421, Marion 46953.
Howard—I. R. Frazer, 113 N. Washington Street, Kokomo 46901.
Lake—Nicholas Bucur, Lake County Building, 4th and Broadway, Gary 46402.
Madison—C. W. Moore, Court House, Anderson 46011.
Marion—E. H. Maxwell, Room G-4 City-County Building, Indiamapolis 46204.
F. L. Brugh, Deputy.
Marshall—G. W. Schultz, Route 1, Bremen 46506.
Miami—Victor Scott, R.R. 1, Bunker Hill 46914.
St. Joseph—C. S. Zmudzinski, Room 14A Court House, South Bend 46601.
Vanderburgh—L. L. Lehr, 1557 Lodge, Evansville 47714.
Vigo—R.J. Silcock, Room 5 Court House, Terre Haute 47802.

City Sealers of Weights and Measures:

Gary 46402—C. C. Morgan, City Hall.
Indianapolis 46204—W. R. Copeland, Room G6 City-County Building.
South Bend 46601—B. S. Cichowicz, City Hall, 214 N. Main Street.
Terre Haute 47801—J. T. Harper, Room 205 City Hall.

IOWA

State—W. E. Weed, Supervisor, Weights and Measures Division, Department of Agriculture, Capitol Building, Des Moines, 50319.

KANSAS

State—J. F. True, State Sealer, Division of Weights and Measures, State Board of Agriculture, State Office Building, Topeka 66612.
J. L. O'Neill, Deputy, Box 26, Williamsburg 66095.

City Sealers of Weights and Measures:

Kansas City 66101___ D. L. LYNCH, Deputy, Department of Finance and Revenue, City Hall.

Topeka 66203_____ D. J. WEICK, Room 254 City Hall.

KENTUCKY

State_____ G. L. JOHNSON, Director, Division of Weights and Measures, Department of Agriculture, Capitol Annex, Frankfort 40601.

City Inspector of Weights and Measures:

Covington 41011 ____ J. R. CROCKETT, License Department, Room 203 City Building.

LOUISIANA

State _____ J. H. JOHNSON, Director, Division of Weights and Measures, Department of Agriculture and Immigration, P.O. Box 44292 Capitol Station, Baton Rouge 70804.

C. S. JOHNSON, Chief Assistant.

F. F. THOMPSON, Chief Chemist, Petroleum Products Division, Department of Revenue, P.O. Box 18374 University Station, Baton Rouge 70821.

MARYLAND

State _____ J. E. MAHONEY, State Superintendent of Weights and Measures, Department of Markets, State Board of Agriculture, University of Maryland—Room 247 Symons Hall, College Park 20742.

R. L. THOMPSON, Assistant.

County Sealer of Weights and Measures:

Prince George's ____ R. J. CORD, 5012 Rhode Island Avenue, County Service Building, Room 101, Hyattsville 20780.

City Sealers of Weights and Measures:

Baltimore 21212 ____ G. H. LEITHAUSER, Room 1106 Municipal Building.

MASSACHUSETTS

City Sealer of Weights and Measures:

Cambridge 02139 ___ A. T. ANDERSON, Room 202 City Hall.

Chelsea 02150 _____ F. J. RYAN, City Hall.

Newton 02159 _____ J. E. BOWEN, City Hall.

Swampscott 01907 __ G. H. HOLT, 39 Essex Avenue.

MICHIGAN

State _____ J. L. LITTLEFIELD, Chief, Food Inspection Division, Department of Agriculture, Lewis Cass Building, Lansing 48913.

R. M. LEACH, Assistant.

C. O. COTTOM, Supervising Inspector.

County Sealer of Weights and Measures:

Saginaw _____ W. E. HOFFMAN, 6358 Mackinaw Road, Saginaw 48604.

City Sealers of Weights and Measures:

Dearborn 48126 ____ O. L. Hubbard, Mayor.
J. A. Hughes, 13030 Hemlock Avenue.
Detroit 48207 _____ J. T. Daniell, 1445 Adelaide Street.
Livonia 48154 _____ R. C. Baumgartner, 15050 Farmington Road.
Pontiac 48058 _____ M. J. Nolin, 110 E. Pike Street.

MINNESOTA

State _____ W. E. Czaia, Supervisor, Department of Weights and Measures, Railroad and Warehouse Commission, One Flour Exchange, Minneapolis 55415.
A. W. Fenger, Inspector.

City Sealer of Weights and Measures:
Minneapolis 55802___ J. G. Gustafson, Room 101A City Hall.

MISSISSIPPI

State_____ P. W. Gaither, Deputy Director, Weights and Measures Division, Department of Agriculture and Commerce, State Office Building, Post Office Box 1609, Jackson 39205.

MISSOURI

State_____ J. H. Wilson, Director, Weights and Measures Division, Department of Agriculture, Jefferson Building, Jefferson City 65102.

County Sealer of Weights and Measures:

St. Louis_____ L. A. Rick, 8008 Carondelet, Suite 206, Clayton 63105.

City Sealer of Weights and Measures:

St. Louis 63103_____ D. I. Offner, Department of Public Safety, Room 414 City Hall.

MONTANA

State_____ C. L. Purdy, Commissioner, Department of Agriculture, Capitol Building, Helena 59601.
G. L. Delano, Chief Sealer, Division of Weights and Measures.
Ed Kelsh, Deputy.

NEBRASKA

State_____ R. W. Hoppner, Chief, Division of Dairies, Foods, Weights, and Measures, Department of Agriculture and Economic Development, P.O. Box 4695 State House Station, Lincoln 68509.

NEVADA

State_____ Raymond Rebuffo, Chief Deputy State Sealer, Bureau of Weights and Measures, Department of Agriculture, 350 Capitol Hill Avenue, P.O. Box 1209, Reno 89504.

NEW JERSEY

State—— Michael Gold, Deputy Attorney General, State House Annex, Trenton.
W. J. Wolfe, Sr., State Superintendent, Division of Weights and Measures, Department of Law and Public Safety, 187 W. Hanover Street, Trenton 08625.
S. H. Christie, Jr., Deputy.
J. R. Bird, Supervisor.

County Superintendent of Weights and Measures:

Essex—— W. H. Schneidewind, 278 New Street, Newark 07103.
Monmouth—— W. I. Thompson, P.O. Box 74, Allenhurst 07711.
J. A. J. Bovie, Assistant, 82 West Wall Street, Neptune City 07753.
W. G. Dox, Assistant, 216 Maple Avenue, Red Bank 07701.
Passaic—— William Miller, 317 Pennsylvania Avenue, Paterson 07503.
Somerset—— J. A. Kriney, Jr., County Administration Building, Somerville 08876.

Municipal Superintendents of Weights and Measures:

Nutley 07110—— Roy Gundersdorff, Director of Public Affairs, Town Hall, Chestnut Street.
W. L. Callanan.
Trenton 08609—— R. J. Boney, 324 E. State Street, City Hall Annex.

NEW MEXICO

State—— J. T. Lacy, State Inspector, Division of Markets, Weights, and Measures, Department of Agriculture, P.O. Box 170, University Park 88070.

NEW YORK

State—— F. J. Fallon, Director, Bureau of Weights and Measures, Department of Agriculture and Markets, Laboratory Building, 1220 Washington Avenue, Albany 12226.
J. F. Tucker, Senior Inspector.

County Sealers of Weights and Measures:

Nassau—— Robert Williams, 1035 Stewart Avenue, Garden City 11533.
A. W. Weidner, Jr., Assistant.
Suffolk—— J. M. Kerbs, County Center, Riverhead 11901.

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Glen Cove 11542—— E. T. Hunter, City Hall, 10 Elsinor Avenue.
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New York 10013—— R. W. Brevoort, Department of Markets, 137 Centre Street.
Moe Greenspan, Assistant.
Syracuse 13210—— J. M. Byrne, 101 N. Beech Street.
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NORTH DAKOTA

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Inspectors:

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OHIO

State—V. D. Campbell, Chief, Division of Weights and Measures, Department of Agriculture, Reynoldsburg 43068.

County Inspectors of Weights and Measures:

Allen—Don Clem, 4305 Southgate, Lima 45806.

Auglaize—Ferd Wellman, 309 S. Main Street, New Knoxville 45871.

Coshocton—W. B. Graham, c/o County Auditor, Court House, Coshocton 43812.

Medina—R. W. Searles, 137 W. Friendship Street, Medina 44256.

Richland—C. E. Kerr, c/o County Auditor, Mansfield.

City Sealers of Weights and Measures:

Akron 44304—R. K. Slough, 69 N. Union Street.

Dayton 45402—Karl Gulledge, 960 Ottawa Street.

OKLAHOMA

State—H. K. Sharp, Assistant Director, Marketing Division, State Board of Agriculture, Capitol Building, Oklahoma City 73105.

L. D. Halley, Special Assistant to the Director for the State of Oklahoma Bureau of Standards, University of Oklahoma Research Institute, 1808 Newton Drive, Norman 73069.

OREGON

State—W. B. Steele, Deputy State Sealer of Weights and Measures, Department of Agriculture, Agriculture Building, Salem 93710.

PENNSYLVANIA

State—W. A. Polaski, Director, Bureau of Standard Weights and Measures, Department of Internal Affairs, Main Capitol Building, Harrisburg 17120.

County Inspectors of Weights and Measures:

Allegheny—W. D. Scott, Court House, Grant Street, Pittsburgh.
E. W. Stec.

Philadelphia—S. F. Valtri, Room 305 City Hall, Philadelphia 19107.
J. A. Sabo.

Washington—P. J. Pavlak, Box 147, Daisytown 15427.

City Sealer of Weights and Measures:

Bethlehem 18018—Castanzo Castellucci, Department of Public Safety, 623 8th Avenue.

SOUTH CAROLINA

State—— C. H. Stender, Deputy Commissioner, Department of Agriculture, P.O. Box 1080, Columbia 29202.
E. W. Ballentine, Director, Bureau of Inspection.

SOUTH DAKOTA

State—— Division of Inspections, Department of Agriculture, State Capitol Building, Pierre 57501.
George Beatty, Inspector.
George Clark, Inspector.
Public Utilities Commission, State House, Pierre 57501.
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J. A. Etzkorn, Inspector.
B. E. Hofer, Inspector.
D. C. Hanna, Senior Inspector, Spencer 57374.
Leonard Bies, Assistant.

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State—— Matt Jennings, Director, Division of Marketing, Department of Agriculture, Melrose Station, Box 9039, Nashville 37204.

TEXAS

State—— R. T. Williams, Director, Consumer Protection and Services, Department of Agriculture, John Reagan Building, Austin 78711.
Charles Vincent, Assistant.

City Sealers of Weights and Measures:

Dallas 75201—— J. D. Walton, Room 303 City Hall.
Forth Worth 76107—— R. L. Sharp, Department of Public Health and Welfare, Public Health Center, 1800 University Drive.

UTAH

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Inspectors:
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State—— J. F. Lyles, Supervisor, Weights and Measures Regulatory Section, Division of Regulatory Services, Department of Agriculture and Immigration, 1436 E. Main Street, Room 304, Richmond 23219.
Inspector:
R. H. Shelton.

City Sealers of Weights and Measures:

Alexandria 22313—— L. W. Vezina, City Hall, P.O. Box 178.
Richmond 23219—— W. G. Alivis, Safety-Health-Welfare Building, Room 130, 501 N. 9th Street.

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WASHINGTON

State—— J. H. Lewis, Chief, Weights and Measures Section, Department of Agriculture, P.O. Box 128, Olympia 98501.

City Sealers of Weights and Measures:

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WEST VIRGINIA

State—— Lawrence Barker, Commissioner, Department of Labor, State Office Building, Room 643, 1800 E. Washington Street, Charleston 25305.

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L. L. Bowen, Instructor, Precision Measurement Equipment School, 801 Hanover, Aurora, Colorado 80010.
D. A. Cutshall, Instructor, Precision Measurement Equipment School, Lowry AFB, Colorado 80230.
R. B. Dodrill, Instructor, Precision Measurement Equipment School. Lowry AFB, Colorado 80230.

U.S. Department of Health, Education, and Welfare:
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R. A. Tucker, Food and Drug Officer, Office of Federal-State Relations, Crystal Plaza, Arlington, Virginia.

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E. E. Wolski, Manager of Quality Control, 300 Park Avenue, New York, New York 10022.
E. S. Wilkins, Associate Counsel, 300 Park Avenue, New York, New York 10022.
Continental Can Company, Bondware Division:
R. F. Orthen, Director of R & D, 1200 W. 76th Street, Chicago, Illinois 60620.
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R. K. Gardner, Supervisor, Weighing Engineering Laboratory, Corning, New York 14830.
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G. D. Reynolds, Jr., Vice President, Sales, 25 Pine Street, New Canaan, Connecticut 06840.
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B. Taylor, Vice President-General Manager, 538 East Town Street, Columbus, Ohio 43215.

Hobart Manufacturing Company:

K. C. Allen, Vice President, Scale Operations, 448 Huffman Avenue, Dayton, Ohio 45403.

M. E. Bone, Weights and Measures Representative, 448 Huffman Avenue, Dayton, Ohio 45403.

C. G. Gehringer, Sales Manager, Industrial Weighing, Pennsylvania Avenue, Troy, Ohio 45373.

Holly Sugar Corporation:

L. W. Norman, General Chemist and Director of Research, P.O. Box 1052, Colorado Springs, Colorado 80901.

J. E. A. Rich, Eastern District Manager, P.O. Box 1052, Colorado Springs, Colorado 80901.

Honeywell, Inc.:

A. R. Parsons, Market Manager, New Products Division, 2701 4th Avenue South, Minneapolis, Minnesota 55404.

Howe Richardson Scale Company:

R. P. Closson, Regional Service Manager, 2839 S. 19th Avenue, Broadview, Illinois 60153.

W. L. Hamilton, Regional Manager, Broadview, Illinois 60153.

G. F. Johnston, Manager-Bulk Handling Division, 668 Van Houten Avenue, Clifton, New Jersey 07013.

G. D. Wilkinson, National Service Manager, Clifton, New Jersey 07013.

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K. H. Baird, Engineering Coordinator, Marketing Department, Operations and Engineering, P.O. Box 2180, Houston, Texas 77001.

Humble Pipeline Company:

L. J. Barbe, Jr., Supervising Engineer, Oil and Meter Measurement, P.O. Box 2220, Houston, Texas 77001.

Hunt-Wesson Foods:

R. E. McKennan, Manager—Food Quality Control, 1645 W. Valencia Drive, Fullerton, California 92633.

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J. T. Lynch, Vice President and General Sales Manager, Grocery Products Division, 1200 Investors' Building, Minneapolis, Minnesota 55402.

Kraft Foods:

C. E. White, Production Technician, 500 Peshtigo Court, Chicago, Illinois 60690.

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R. S. Day, Assistant Sales Manager, Industrial Instruments, 4901 Stenton Avenue, Philadelphia, Pennsylvania 19144.

Lehn & Fink Products Corporation:

F. Taylor, Chairman, CSMA Aerosol New Weight Committee, 225 Summit Avenue, Montvale, New Jersey 07645.

Lever Brothers Company:

L. H. Bloom, Attorney, 390 Park Avenue, New York, New York 10022.
W. L. Button, Jr., Plant Operations Manager, 390 Park Avenue, New York, New York 10022.

Liberty Glass Company:

E. K. Mills, Technical Director, P.O. Box 520, Sapulpa, Oklahoma 74066.

Lily-Tulip Cup Corporation:

D. F. McMahon, Assistant to the Vice President, 122 E. 42nd Street, New York, New York 10017.

Lincoln Steel Corporation:
L. E. Luff, Design Engineer, 315 West "O" Street, Lincoln, Nebraska 68508.
J. M. Smith, Sales Engineer, 315 West "O" Street, Lincoln, Nebraska 68508.
Lion Oil Company:
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Mantes Scale Company:
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L. F. Markle, Scale service, manufacture and repair, 1390 S. Eaton Street, Denver, Colorado 80226.
Martin-Decker:
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C. L. Howard, General Sales Manager, 3431 Cherry Avenue, Long Beach, California 90807.
J. Shelley, Industrial Sales Manager, 3431 Cherry Avenue, Long Beach, California 90807.
Maryland Cup Corporation:
L. S. Rome, Owings Mills, Maryland 21117.
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D. L. Paul, General Product Controller, 910 Mayer Avenue, Madison, Wisconsin 53704.
McDowell-Wellman Engineering Company:
R. J. McEntee, Sales Manager, ABC Scale Division, 16300 S. Waterloo Road, Cleveland, Ohio 441110.
Merrick Scale Manufacturing Company, Inc.:
R. H. Jackson, Sales Manager, 180 Autumn Street, Passaic, N. J. 07055.
L. J. Walker, Project Engineer, 180 Autumn Street, Passiac, New Jersey, 02055.
Mid-America Pipeline:
G. E. Mace, Chief Engineer, 1437 S. Boulder, Tulsa, Oklahoma 74119.
Miltz Industry Foundation:
J. F. Speer, Jr., Executive Assistant, 910 17th Street, N.W., Suite 1105, Washington, D.C. 20006.
Millers' National Federation:
O. A. Oudal, Weights and Measures committee, 1411 East 99th Streeet, Minneapolis, Minnesota 55420.
Mobil Oil Corporation:
J. C. Dible, Maintenance Supervisor, 4545 Holly Street, Denver, Colorado 80216.
Murphy Scale and Equipment Company:
W. V. Goodpaster, Vice Pressident-Manager, 1800 West Colfax, Denver, Colorado 80204.
National Association of Margarine Manufacturers:
R. J. Leighton, Assistant to the President, 545 Munsey Building, Washington, D.C. 20004.
National Canners Association:
H. P. Schmitt, Director, Labeling Program and Assistant to Executive Vice President, 1133 20th Street, N.W. Washington, D.C. 20036.
National Confectioners Association:
J. M. Scheer, Director of Special Services, 36 South Wabash Avenue, Chicago, Illinois 60603.

National Fisheries Institute:

T. D. Sanford, Director, Tecnology, 1614 20th Street, N.W., Washington, D.C. 20009.

National LP-Gas Association:

W. H. Johnson, Vice President, 79 W. Monroe Street, Chicago, Illinois 60603.

Neptune Meter Company:

B. A. Balendonck, Sales Department, 5540 E. Harbor Street, Los Angeles, California 90022.

A. C. Kisling, 5540 E. Harbor Street, Los Angeles, California 90022.

W. A. Medord, Engineer, 47–25 34th Street, Long Island City, New York 11101.

E. F. Wehmann, Manager, Engineering Administration, 47–25 34th Street, Long Island City, New York 11101.

Olin Mathieson Chemical Company:

R. F. Philpitt, Manager, Legislative aand Regulatory Affairs, 745 5th Avenue, New York, New York 10022.

Owens-Illinois, Inc.:

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J. W. Hale, Technical Representative, 8A1 Phillips Building, Bartlesville, Oklahoma 74003.

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C. E. Joyce, Manager, Customer and Product Protection, 608 2nd Avenue, South, Pillsbury Building, Minneapolis, Minnesota 55402.

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G. Hopper, Legal Division, 301 East 6th Street, Cincinnati, Ohio 45202.

L. Theohorous, Associate Director, Product Development Division, Ivorydale Technical Center, June Street and Spring Grove Avenue, Cincinnati, Ohio 45217.

Quaker Oats Company:

F. A. Dobbins, Quality Control Manager, Mechandise Mart Plaza, Chicago, Illinois 60654.

Ramsey Engineering Company:

R. J. Bierman, Manager, International Division, 1853 West County Road C, St. Paul, Minnesota 55113.

B. Cahill, Sales Manager, 1853 West County Road C, St. Paul, Minnesota 55113.

W. M. Harris, Senior Systems Engineer, 1853 West County Road C, St. Paul, Minnesota 55113.

B. Wilson, Field Engineer, 1166 Elati Street, Denver, Colorado 80204.

Republic Steel Corporation:

D. R. Smith, Corporation Weighing Supervisor, 410 Oberlin Road, S.W., Massillon, Ohio 44646.

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P. S. Wells, President, 845 North Colony Road, Wallingford, Connecticut 06493.

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Soap and Detergent Association:

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A. M. Fallon (Miss), Staff Member, Editor Digest and Legislative Services, 295 Madison Avenue, New York, New York 10017.

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D. B. Kendall, Manager, Product Engineering, 5225 Telegraph Road, Toledo, Ohio 43612.

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F. W. Love, Administrative Assistant, Engineering Department, West College Avenue, Salisbury, Maryland 21801.

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C. G. Johnson, General Supervisor, Room 450 Union Station, Chicago, Illinois 60606.

Other Guests

L. J. Gordon, Weights and Measures Research Center, Denison University, 117 Locust Place, Granville, Ohio 43023.

J. H. B. Hornby, Deputy Chief Inspector of Weights and Measures, 5 Thesiger Road, Abingdon, Berkshire, England.

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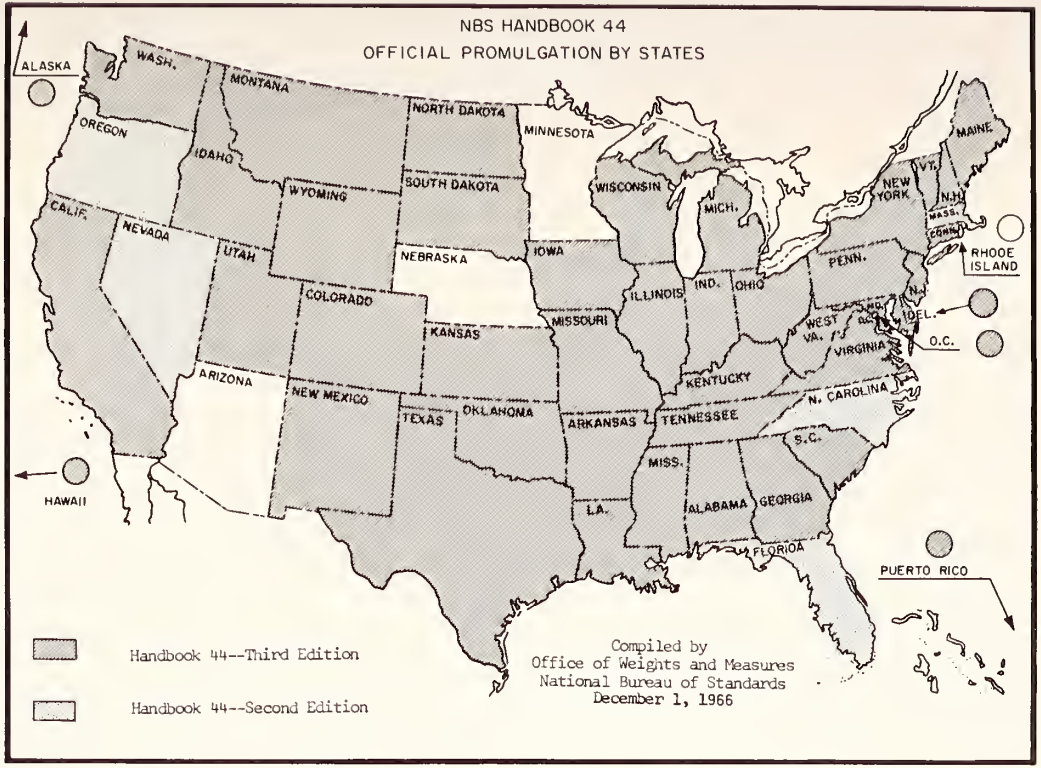

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